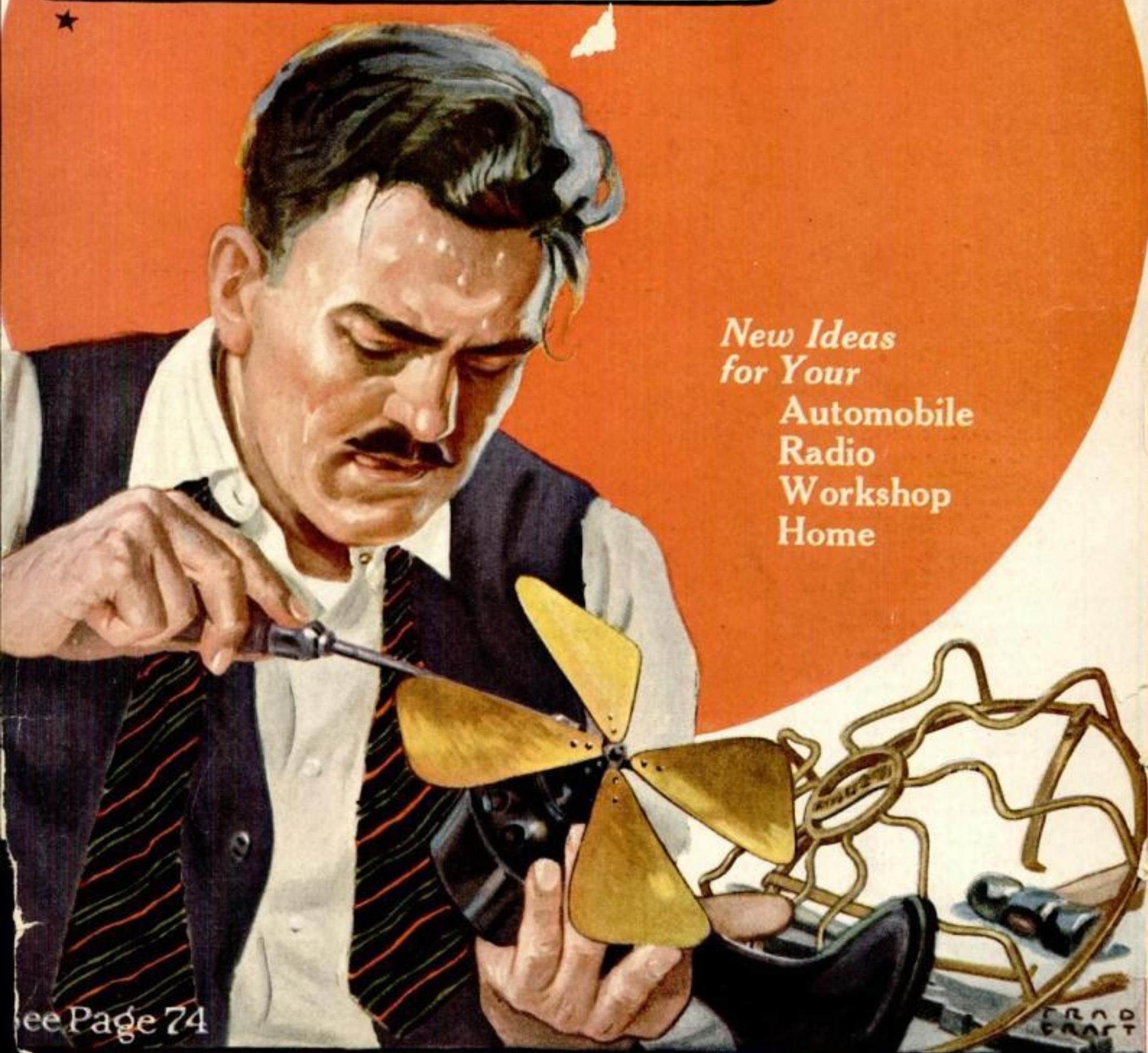


Popular Science

FOUNDED **MONTHLY** 1872

New Ideas
for Your
Automobile
Radio
Workshop
Home



See Page 74

JULY

Most Wonderfully Illustrated Magazine in the World

25 CENTS

Radio in the Presidential Campaign



Watch the radio columns of your newspaper for the big convention broadcast schedules.

Radiola Super-Heterodyne

is the great Radiola for the big events of summer broadcasting. Listen in, at your office, to the conventions and the ball games. Take it everywhere. It needs NO ANTENNA — no ground—no connections of any kind. Has a handle to lift it by. Tunes in with just two knobs that you turn to marked spots on the dials. Tunes out powerful near stations to get the far ones. A wonderful new achievement in the perfection of its tone—its sensitivity—and its supreme selectivity!

Complete with six Radiotrons UV-199 and Radiola Loudspeaker; everything except batteries . . . \$286

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Operates
on Dry Batteries



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There are many Radiolas at many prices. Send for the free booklet that describes them all.

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Dept. 117 (Address office nearest you.)
Gentlemen: Please send me your free Radio Booklet.

Name _____

Address _____

No "influence" needed this year for a gallery seat at the big political conventions! Get it all with a Radiola Super-Heterodyne.

When the delegates march in—their banners streaming; when the bands play and the galleries cheer—be there with a "Super-Het." Hear the pros and cons as they fight their way to a "platform" for you. Hear the speeches for the "favorite sons." The sudden stillness when the voice of a great speaker rings out. The stamp and whistle and shrill of competitive cheering. Hear the actual nomination of a president.

It used to be all for the delegates' wives and the "big" folks of politics. Now it's for everybody. Listen in. Get it all! With the newest Radiola.

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433 California St., San Francisco, Cal.



Radiola

REG. U. S. PAT. OFF.



Approved by Over 200 Experts

New Crosley Engineering Achievement

A THREE tube set with five tube efficiency—the greatest selectivity with the minimum effort—positive calibration to any wave length between 200 and 600 meters. These are only a few of the many advantages offered in the remarkable new Crosley Trirdyn Radio Receiver.

It was only after a year of constant experimenting, that our engineering department perfected this exceptional receiver. Thorough tests proved to us that it would out-perform any receiver ever before produced. But we were not satisfied with our own opinion. So we shipped out 200 of these sets to experts in every part of the United States. Their criticisms are one and the same—"tried out your new Trirdyn Receiver Saturday night and logged 13 stations, among them Cuba, New York and Omaha, between 9 and 10 o'clock. The set was very selective. During the time this test was on, local station KSD was operating and we went through them without any difficulty or interference whatever. The range of the local station was not more than three points variation in the dial setting."

"Tried one of these sets out and obtained wonderful results. Were able to log all stations which we heard very successfully. This set should go over big." "The set has wonderful volume and is selective"—etc.

This new Crosley triumph is called the Trirdyn because of its original combination of the three "R's"—Radio frequency amplification, Regeneration and Reflex. The first tube incorporates non-oscillating, non-radiating tuned radio frequency amplification; the second tube, a regenerative detector reflexed back on the first tube for one stage of audio frequency amplification. Then it has a third tube which acts as a straight audio frequency amplifier. It uses the ultra selective asperiodic antenna circuit and external selector coil, which adds to its wonderful selectivity.

The Crosley Trirdyn in range, volume and selectivity is the equal of any five tube receiver on the market. Greater volume will, of course, be obtained through the use of storage battery tubes, but it will function well in any type and can be used with either indoor or outdoor antenna.

The opinions of many experts have convinced us that the Trirdyn is the best receiver ever offered the public regardless of price.

Practically every radio dealer can furnish you Crosley Radio Sets including not only the Trirdyn, but the Model 51, a two tube set for only \$18.50; the Model V, a single tube receiver at \$16.00; the Model VI at \$24.00; the Super VI at \$29.00; the Model X-J at \$55.00 and the Super X-J at \$65.00.

All Crosley Regenerative Sets
are licensed under Armstrong
U. S. Patent No. 1,113,149

CROSLEY
Better-Cost Less
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Receiving Sets than any other
Manufacturer in the World

SEE THIS NEW WONDER AT YOUR DEALERS

THE CROSLEY RADIO CORPORATION

POWEL CROSLEY, JR., President

Formerly The Precision Equipment Company and Crosley Manufacturing Company

717 Alfred Street,

Cincinnati, Ohio

Popular Science Monthly

Most Wonderfully Illustrated Magazine in the World

JULY, 1924; Vol. 105, No. 1
25 cents a Copy; \$2.50 a Year



Published in New York City at
225 West Thirty-ninth Street

In the Next Issue

A House of Wonders in which Science is the host has just opened its doors at the national capital, inviting you and every other American to enter freely and see the world's newest marvels through the eyes of the most modern scientific instruments. Raymond J. Brown has visited this great public shrine of knowledge. In next month's issue he will tell you what he found there.

Mars comes its closest to us on August 22, reviving keen interest in the dream of exchanging signals across 35,000,000 miles of empty space with possible inhabitants of our brother planet. What if messages from the Martians actually were received this summer? How could we decode them and learn their meaning? The one writer who can discuss this fascinating question scientifically, yet with all the glamour and romance of adventure, is Lieutenant-Commander Fitzhugh Green, U. S. N., whose recent forward-looking articles in POPULAR SCIENCE MONTHLY have aroused tremendous interest. Don't miss his great story of Mars next month.

Are you afraid of lightning? You need not be, once you understand the scientific secrets of its origin and actions, and learn how to avoid its dangers. Amazing facts about Nature's greatest show, told by an authority on the subject in next month's issue, will help allay your fears of the thunderstorm.

That costly error—how did it happen? There it is, yet you are at a loss to explain the glaring slip-up in your usually painstaking work. An eminent psychologist tells why you are more liable to mistakes during the heat of summer, and how you can avoid them.

And more than 200 other fascinating articles and pictures giving you all the news of science and invention, together with practical ideas for radio, the automobile, the home, the home workshop, and the use of tools and machinery.

In the new House of Wonders opened to the public at Washington, D. C., you can see how your voice sounds, simply by talking into a telephone and looking at the sounds on a glass screen



POPULAR SCIENCE MONTHLY

Issued monthly. Single copy, 25 cents. Yearly subscription to United States, its possessions, and Canada, \$2.50; foreign countries, \$3.

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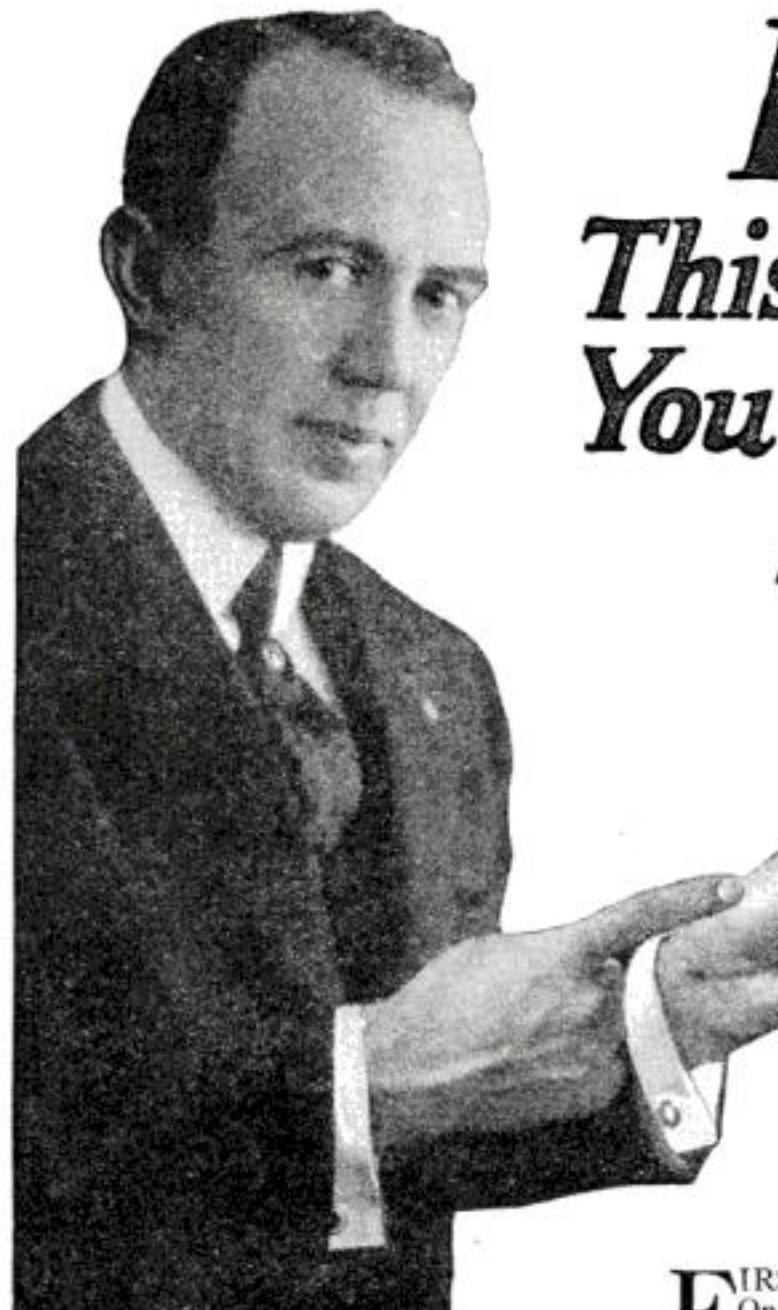
In presenting in its editorial columns numerous stories of new products of applied science, "POPULAR SCIENCE MONTHLY" does not underwrite the business methods of the individuals or concerns producing them. The use of POPULAR SCIENCE MONTHLY articles, or quotations from them for stock-selling schemes is never authorized.

H. J. Fisher, President R. C. Wilson, Vice-President
O. B. Capen, Secretary and Treasurer

In This Issue

	Page
Radio's Part in Politics.....	21
By Edward G. Lowry	
How I Make Stage Sunlight.....	24
By David Belasco	
Desert Cliffs Yield Ancient Secrets..	26
The World's Greatest Spectacle....	27
By Raymond J. Brown	
"Flying Autos in 20 Years".....	30
By E. V. Rickenbacker	
Dynamite in Industry.....	31
By H. E. Davis	
What to Do with a Good Idea.....	32
By Frank G. Rinsche	
Oddities of Home Workmanship....	34
How I Became a Daredevil.....	35
By Hilary Long	
Masterpieces of Insect Architects...	37
New Vistas of Science.....	38
Your Meals and Your Health.....	40
By Walter H. Eddy, Ph.D.	
Movies Show Workmen's Efficiency...	42
Handy New Tire Deflator.....	42
Tractors Move Huge Boiler.....	42
A "Turntable Home".....	43
Collapsible Traffic Signal.....	43
Pocket Clothes Brush.....	43
Speedy Egg-Washing Machine.....	44
Tiny Pencil in Finger Ring.....	44
Wind Tests of Automobiles.....	44
Wheelbarrows with Pneumatic Tires.	45
Spotlight Aids Bandsman.....	45
Railroad Conquers High Peak.....	45
Soap from Holly.....	46
Folding Pocket Microscope.....	46
Ice-Age Grasshoppers in Glacier....	46
A Boarding-House for Bacteria.....	47
Windows Tested in Furnace.....	47
New Fuel from Lignite.....	47
The Oldest and Smallest Books.....	48
World's Largest Bell.....	48
Pencil and Vanity Case Combined...	48
Models of Famous Locomotives....	49
Radio through Solid Rock.....	49
To Market by Motorcycle.....	49
New Motor Fuel Silences Knocks	50
Better Tools for the Housewife.....	51
Electric Bench Woodworker.....	52
Weighted Ash-Tray Won't Spill.....	52
Sprocketless Movie Camera.....	52
"X-Ray" Test for Highways.....	53
Pneumatic Automobile Springs...	53
Telescope and Microscope in One...	53
Pocket Calculating Machine.....	54
Weighted Extension Lamp.....	54
Electric Screwdriver and Wrench...	54
Novel Pistol Watch.....	55
Armature Holds 172 Men.....	55
Alcohol as a Pipe-Cleaner.....	55
A Business of Spider Webs.....	56
The World's Largest Shell.....	56
Imitating the Crow's Call.....	56
Feeds Calf by Clockwork.....	57
Midget and Monster Armatures.....	57
A Giant Radio Insulator.....	57
"Sheep Dip" for Autos.....	58
Lightweight Car without Chassis...	58
Kerosene Spray Cleans Engine.....	58
Two-Way Road-Building Truck.....	59
A New Trouble Light.....	59
Electric Clock Times Runners.....	60
Metal Bucket for Berry Picking.....	60
How Much Science Do You Know? ..	60
Safety Drain for Gas Pipes.....	61
Vest Pocket Fire Escape.....	61
Know Your Car.....	61
Adventures in Home Ownership.....	62
By Phil M. Ridley	
Two Radio Sets in One.....	64
By Joseph Calcaterra	
Setting the Pace in Radio.....	65
By Jack Birns	
Confessions of a Used-Car Gyp.....	67
New Ideas for the Motorist.....	69
The Home Workshop.....	71
Better Shop Methods.....	76

And other timely articles
and pictures



I Tell You This Free Book Will Show You The Way to Amazing Salary Increases



I only ask that you risk two cents on the strength of my word that the contents of this amazing book will show you the way to a prosperity that you never dreamed possible, in a fascinating field that you never thought of entering.

*This book is now free.
Read my offer.*

By J. E. GREENSLADE

FIRST let me ask you two questions. One: Do you consider that you are as intelligent as the average mail-clerk, farmhand, office clerk, mechanic, or bookkeeper? I ask you this because most of the men whose salaries have jumped are just ordinary, every-day sort of men.

Second: If you suddenly found yourself with all the money you needed to spend, wearing the best clothes, living in the finest neighborhood, driving a good car and belonging to the best clubs—but having to make good in a job that paid \$10,000 a year, would it scare you? There are men to whom \$10,000 a year is so much that the idea of earning it themselves never occurs to them. They will always be in routine jobs at low pay. Their dreams will never come true. But yours will if you will absorb what I am going to tell you. For my work in life is to take ordinary men from blindalley jobs and show them how they can quickly make more money than they ever dreamed possible. And if you will give me a chance I'm going to show you how it's done!

Now, in one quick step you can enter the field where opportunities in your favor are ten to one—the Selling field. You know that Salesmen top the list of money-makers—that the salesman is his own boss—that his work is fascinating, interesting and highly profitable. But the thing you doubt is your own ability. All right, but you can become a first-class, money-making salesman in an amazingly easy way.

Proof That Salesmen Are Made —Not “Born”

You might laugh if I told you that in a few weeks or months you could be making good in a big way in the Selling field. Thousands before you have laughed—perhaps bitterly—at the idea, but many of these thousands are now making big money as salesmen.

The story of six men who once thought salesmen were “born,” who did not believe they were “cut out for selling,” is on this page.

Thousands of men like these six—men who formerly thought salesmen were “born,” are now enjoying magnificent earnings in the selling field. They were bookkeepers, mechanics, farmers, clerks—even doctors, lawyers and ministers—but in a few months after writing to the National Salesmen's Training Association they were out in the field selling—and making more money than they had ever helped to make in their former vocations.

Sounds remarkable, doesn't it? Yet there is nothing remarkable about it. Salesmanship is governed by rules and laws. There is a certain way of

saying and doing things, a certain way of approaching a prospect to get his undivided attention, certain ways to overcome objections, batter down prejudice, overcome competition and make the prospect act.

Just as you learned the alphabet, so you can learn salesmanship. And through the NATIONAL DEMONSTRATION METHOD—an exclusive feature of N. S. T. A. System of Salesmanship Training—you gain actual experience while studying.

The NATIONAL DEMONSTRATION METHOD gives you experience and knowledge that enable you to overcome sales obstacles of all descriptions easily. It is one of the many reasons why N. S. T. A. members make good salesmen right from the start.

A Lifetime of Selling Experience in a Few Weeks—Then Success

No matter what you are doing now, I can prove to you that you can gain years of selling experience in a few weeks—that you can go out and successfully sell goods—that you can make more money than you ever dreamed possible.

The N. S. T. A. System of Salesmanship Training and Employment Service will enable you to quickly step into the ranks of successful salesmen—will give you a big advantage over those who lack this training. It will enable you to jump from small pay to a real man's income.

Remarkable Book, “Modern Salesmanship,” Sent FREE

With my compliments I want to send you a most remarkable book, “Modern Salesmanship.”

It will show you how you can easily become a Master Salesman—a big money-maker—how the N. S. T. A. System of Salesmanship Training will give you years of selling experience in a few weeks; how our FREE Employment Service will help select and secure a good selling position when you are qualified and ready. And it will give you success stories of former routine workers who are now earning salaries as salesmen. Mail the coupon today. It may be the turning point in your life.

NATIONAL SALES MEN'S TRAINING ASSOCIATION

Dept. 15-H

53 W. Jackson Blvd.

Chicago



NATIONAL SALES MEN'S TRAINING ASSOCIATION

National Salesmen's Training Association
53 W. Jackson Blvd., Dept. 15-H, Chicago, Ill.

I simply want to see the facts. Send me free your book “Modern Salesmanship,” and Proof that I can become a Master Salesman.

Name.....

Address.....

City..... State.....

Age..... Occupation.....

Read What They Say

\$9,000 First Year

Ellis Sumner Cook, 58 Superior St., Oak Park, Ill., left a \$25 a week job and last year made \$9,000!

\$100 a Month to \$100 a Week in Only 3 Months

H. D. Miller, another Chicago boy, was making \$100 a month as a stenographer in July, 1922. In September, 3 months later, he was making \$100 a week as a salesman.

\$150 to \$500 a Month

W. P. Clenny of Kansas City, Mo., stepped from a \$150 a month clerkship into a selling job at \$500 a month. He is making \$850 a month now.

\$6,500 a Year

M. V. Stephens of Albany, Ky., was making \$25 a week. He took up this training and now makes 5 times that much.

Small Pay to Big Earnings

J. H. Cash of Atlanta, Ga., exchanged his \$75 a month job for one which pays him \$500 a month.

Now Sales Manager at \$10,000 a Year

O. H. Malfroot of Boston, Mass., stepped into a \$10,000 position as a SALES MANAGER—so thorough is this training. All these successes are due to this easy, fascinating and rapid way to master certain invincible secrets of selling.

EMPLOYERS

are invited to write to the Employment Dept. of the N. S. T. A. We can put you in touch with just the men you need. No charge for this service to you or our members. Employers are also cordially invited to request details about the N. S. T. A. Group Plan of instruction for entire sales forces. Synopsis and charts sent without obligation.

**AUTOMOBILES AND ACCESSORIES**

AUTOMOBILE Parts—Used parts for most any car at half factory list prices. Allen, Briseoe, Buick, Cadillac, Chalmers, Chevrolet, Dodge, Dort, Grant, Hudson, Hupmobile, Oakland, Overland, Oldsmobile, Reo, Studebaker and many others. Send list of parts wanted. Maxwell Bros., 4105 Olive Street, St. Louis, Missouri.

PATENTS—Write for our Guide Books and "Record of Invention Blank" before disclosing inventions. Send model or sketch of your invention for our free Examination and Instructions. Terms reasonable. See advertisement on page 103. Victor J. Evans & Co., 189 Ninth, Washington, D. C.

\$1.25 BUYS a positive Headlight Tell-tale. Handy Specialty Co., Somerville, Mass.

SPORT Speedster and racing bodies for Fords; build to order. Build your own Bucket Seat speedster. Send \$1.00 for blue prints, instructions, and life size paper patterns, complete; Keller Auto Body Co., Inc., Dept. 24, 317 W. Winkler Ave., Louisville, Ky.

NO Car is Modern unless having the Auto-Lavatory that keeps motorists clean. Instant Service Soap and Water. Automobile Show Sensation. Special Demonstrator Price. Distributors Wanted. Emmons Manufacturing Co., Canton, Ohio.

MONEY!—Silvering autolights, radiators, mirrors, Refinishing tableware, stoves, brass beds, etc. Outfits, Methods free. Write—Sprinkle-Plater, Dept. 96, Marion, Indiana.

WHAT do you need? We have it. Gray's Auto Parts Company, 3212 Brighton Road, Pittsburgh, Pennsylvania.

M. P. LAUGHLIN—Patents-Engineer-Attorney-Specializing Power-Automotive Inventions. 47 West 42nd St., New York.

BUY a Gas Gun for \$2.50 and avoid stopping on the road because out of gas. Handy Specialty Co., Somerville, Mass.

FORD ACCESSORIES

SPEEDSTER fans—see "Red-i-Kut" ad, page 108.

MOTORCYCLES, BICYCLES, SUPPLIES

OVERSTOCKED—200 Used Motorcycles. Must be sold at once. We have Harley-Davidsons, Indians, Hendersons, Excelsiors, Clevelands. Prices \$25.00 up. Write for our Bargain List. Myerow Brothers, Dept. C, 15 Berkeley St., Boston, Mass.

DON'T buy a bicycle motor attachment until you get our catalogue and prices. Shaw Mfg. Co., Dept. 4, Galesburg, Kansas.

USED parts for all motorcycles cheap. Schuck Cycle Co., 1922 Westlake, Seattle, Wash.

MOTORCYCLE sidecars—Bargain prices on experimental and discontinued models. Write Flexible Co., 437 Water Street, Louisville, Ohio.

MODELS AND MODEL SUPPLIES

WE make working models for inventors and experimental work, and carry a complete stock of brass gears and model supplies. Send for catalogue. The Pierce Model Works, Tinley Park, Illinois.

MOTORS, ENGINES AND MACHINERY

MOTORS—Manufacturer's Surplus Sale. 1/4 HP, \$8.50; 1/2 HP, \$32.50; 1 HP, \$54.50. 8 Volt Charging Generators, \$8.50. Complete Lighting Plants—Generators—Light Machinery. Write for Catalog. Motor Specialties Co., Crafton, Penna.

BIJUR Generators, brand new, 6 volts, maximum output 22 amperes at 2000 r. p. m. Government paid \$15.00 each, our price \$10.00. General Sales Company, 1921 S. Michigan Avenue, Chicago, Illinois.

CONCRETE Building Block Machines and Molds. Catalogue free. Concrete Manufacturing Co., 307 So. Third St., St. Louis, Mo.

MANUFACTURING

DIES, Tools and General Manufacturer. Models and manufacturing of new inventions our specialty. Logan Machine Co., 222 S. Clinton St., Chicago, Ill.

ELECTRICAL

ELECTRICAL and Cetricaly outifts. Fractional H. P. and Toy motors. Electric Grinder and Buffer for the home mechanic, garages, and repair shops. Literature free. Prices reasonable. A. Uri, 333B, W. Manhattan Blvd., Toledo, Ohio.

AVIATION

THE American School of Aviation announces a new correspondence course in mechanics of aviation. A thorough training in practical aerodynamics. American School of Aviation, Dept. 674-B, 3601 Michigan Ave., Chicago, Illinois.

WANTED

TYPISTS—Earn \$25-\$100 weekly in spare time copying authors' manuscripts. Write R. J. Carnes, P-1, Tallapoosa, Georgia, for particulars.

OLD gold, silver and platinum for cash. Penn Laboratories, 222 Market St., Newark, N. J.

DETECTIVES—Excellent opportunity. Fascinating work. Experience unnecessary. Particulars free. Write American Detective System, 1968 Broadway, New York.

WANTED: Light Machinery, Lathes, Drill Presses, Model High Speed Gasoline and Steam Motors. Best Cash Prices Paid. Motor Specialties Co., Crafton, Penna.

AMERICAN MADE TOYS AND NOVELTIES

OPPORTUNITY to start Manufacturing Metal Toys and Novelties. No experience necessary. Enormous demand exceeds supply. We furnish, at cost, casting forms for production and buy entire output, also place yearly contract orders. Casting forms made to order. Catalog, advice and information free. Metal Cast Products Co., 1096 Boston Road, New York.

Money Making Opportunities for "Popular Science" Readers

Another \$25.00 IN PRIZES

To win one of these cash prizes is easy, and every reader is invited to enter this fascinating competition. Just write a letter of not over seventy words answering this question:

What Advertisement of "Money Making Opportunities" in this issue interests you most and why?

Here are the prizes we will pay for the ten best letters answering the above question:

First Prize	\$10.00
Second Prize	5.00
Third Prize	3.00
And 7 Prizes of \$1.00 each	7.00

First read every one of the "Money Making Opportunity" advertisements on pages 4 to 17. Check the ones that interest you. Then read over the ones you have checked and decide on the one that interests you most.

Then write a short letter, *not more than seventy words*, telling us why the advertisement you pick interests you most. Remember that ten prizes will be awarded. You have a good chance of winning one of them. Be sure to mail us your answer before July 1st. The prizes will be awarded, in the order of their merit, for the letters that are most interesting and best expressed.

The names of all the prize winners and the letters that win the first two prizes will be printed in this column in the September issue. Address your prize letter to

Contest Editor

POPULAR SCIENCE MONTHLY
225 West 39th Street, New York City

Last Month's Prize Winners

The First Prize of \$10.00 goes to John Chirgwin, Mineral Hills, Iron River, Michigan, for his letter on the advertisement of W. Hillyer Ragsdale. Here is Mr. Chirgwin's letter:

Dear Sirs:—
Money Making Opportunities offered through Popular Science have been of benefit to me several times, but the time I most needed—the services offered by W. Hillyer Ragsdale—I received just when I needed it most. I can boast the advertisement through your magazine, as it put me on the road to success and independence. I can tell the world all advertisements in Popular Science are O. K. because Popular Science is a reliable publication.

JOHN CHIRGWIN.

Walter Kelly, Minonk, Illinois, wins the Second Prize for the following letter regarding the advertisement of Wells and Edwards, Chicago, Ill. Here is Mr. Kelly's letter:

Dear Sirs:—
"Money Making Opportunities" is very properly and rightfully named.

Youman's Guide, found under FORMULAS, afforded the opportunity.

The reliability of Popular Science Monthly gave me the confidence in the advertisements so that I took the time to look them over carefully which resulted in answering the above named ad.

It proved to be a most profitable move, enabling me to earn, at odd times, many times over the amount expended.

WALTER KELLY.

The Third Prize goes to Norman K. Reynolds, Spruce Creek, Pa.

The Winners of the other seven prizes are:

Martin DeVries, Tranquillity, Cal.; F. B. Clark, Tifton, Georgia; G. D. Reynolds, Altoona, Pa.; Harry Frye, Tallahoma, Tenn.; Jerry Zerra, Feeding Hills, Mass.; Eleanor C. Brooks, Charleston, W. Va.; H. C. Trichan, Salem, Oregon.

Rate 25 Cents a Word. Advertisements intended for the September issue should be received by July 5th.

RADIO AND SUPPLIES

LAMBERT'S Reclaim-Out Crystals. The kind I use on my famous DX crystal sets that reach out and bring in concerts 400 to 1000 miles away. Mounted, 60¢ each, two for \$1.00. Unmounted, 40¢ each, three for \$1.00. Fixed detector, \$1.50. Mailed postpaid the day I get your order. Leon Lambert, 555A South Voluntia, Wichita, Kansas.

RADIO Generators: 500V 100 watt, \$28.50. Battery Charging Generators, \$8.50. High Speed Motors, Motor Generator Sets all sizes. Motor Specialties Co., Crafton, Penna.

RADIO tubes, D11, D12, UV190, UV200, UV201A, \$4.25. Dutch radio tubes, D12, D200, D201A, \$2.50. Crystal set, 50¢. Add postage. Radio Sales Co., 1168 North Kingshighway, St. Louis, Mo.

WANTED—Representative in every town. Small investment. Large Profits. Write for particulars to Ray-Dee-Artcraft Instrument Co., Redlands, Calif.

LOUD Speaking Crystal Set. Broadcasting heard throughout house. Easily constructed. Instructions complete 25¢. Catalog free. Steinmetz Wireless Mfg. Co., 5810 Penn Ave., Pittsburgh, Pa.

SUPER radio A and B circuit batteries, which bring in long distance reception. Sold for ease or on payment plan. Write for prices and details. Radio Battery Corporation, 501-B Industrial Bank Bldg., Flint, Mich.

RECHARGE your worn out "B" Battery for 10¢. Formula and Instructions 50¢ postpaid. Monarch Sales Company, O-w-e-go, N. Y.

RADIO Tubes repaired and exchanged; write for free circular, "How to do Away with Storage Batteries on All Tubes." C. F. E. Radio Tube Works, Essex Court, Newark, N. J.

RADIO sets: Super-Heterodynes, Neutrodynes and other standard types all makes; guaranteed: 50¢ off list. Why pay more? Send for bulletin 245 Radio Exchange, 925 Broadway, New York.

FOR THE HOME

HOME weaving—looms only \$9.90. Big money in weaving rugs, carpets, portieres, etc., at home from rags and waste material. Weavers are rushed with orders. Send for free loom book, it tells all about the weaving business and our wonderful \$9.90 and other looms. Union Loom Works, 482 Factory St., Bownville, New York.

GRANDFATHER clock works \$5.00. Build your own case, instructions free; make good profits selling your friends. Clock works with chimes for old or new cases. Write for full particulars. Clock Co., Nicetown, Penn.

GASOLINE lamps, lanterns and heaters. Catalog free. Little Wonder Mfg. Co., Terre Haute, Indiana.

KIDDY Cabinets—Ornamental, fascinating, useful, instructive. Actual size patterns. Instructions, 25¢. Me. coin. Guaranteed satisfaction. Bogrens Kiddie Cabinets, 2651-8th Ave., New York.

IMPROVED MADE TOYS

MAKE Improved Metal Toys and Novelties at home with our outfitts and earn big money. No experience necessary. We purchase all your products made to our specifications and pay high prices all year round. Big demand. Write for free catalog and information. Improved BF Metal Casting Co., 342 East 145th Street, New York.

TRADE SCHOOLS

PAINT Automobiles, Trim Automobiles. Become a Certified Electrician, Auto Battery Builder, Ignition Expert on Starting and Lighting, Metal Finisher, and a complete course in Auto-Repairing, Bricklaying and Plastering. We fit you for a big money job. Make you an expert able to step right into a position paying \$45 to \$100 per week. You are paid while learning. We maintain our own dormitories. Come to Detroit, the Automobile hub; the World's wonder city. Write today. Standard Trades School, 416 Woodward, Detroit, Mich.

ADDING MACHINES

FREE trial, in previous free adding machine. Adds, subtracts, multiplies, divides, automatically. Work equals \$350.00 machine. Price only \$15.00. Speedy, durable, handsome. Five-year guarantee. Used by largest corporations. Write today for catalog and free trial offer. Lightning Calculator Co., Dept. O, Grand Rapids, Michigan.

FORMULAS

"YOUMAN'S GUIDE" contains best 5,000 formulas and recipes for every trade, business, occupation, housewife. Let this book make you money. Money-back guarantee. Paper cover \$1.25, Cloth \$2.00. Post-paid. Circular, book catalog free. Wells and Edwards, Department M, 852 George, Chicago.

LABORATORY AND CHEMICAL SERVICE

EXPERIMENTERS. Complete supplies for the chemical laboratory. Catalogue 5c. National Scientific Supply Co., 241 Pennsylvania Avenue, Washington, D. C.

YOUR chemical problem solved and working process furnished for five dollars. Write me. W. Steedman Richards, Consulting Chemist, Box 2402, Boston, Mass.

CHEMICAL expert furnishes manufacturing formulas with complete working directions, resulting products possessing distinct individuality and merit. Processes perfected. All lines. No lists of worthless stock formulas but reliable individual service. Charges reasonable. Correspondence invited. Dr. Arthur Van Heeden, 508 South Oakley Boulevard, Chicago.

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**More Money Making Opportunities
on pages 6 to 17**



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* * *

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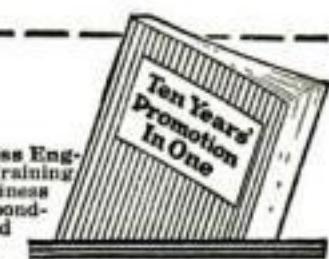
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More Money Making Opportunities
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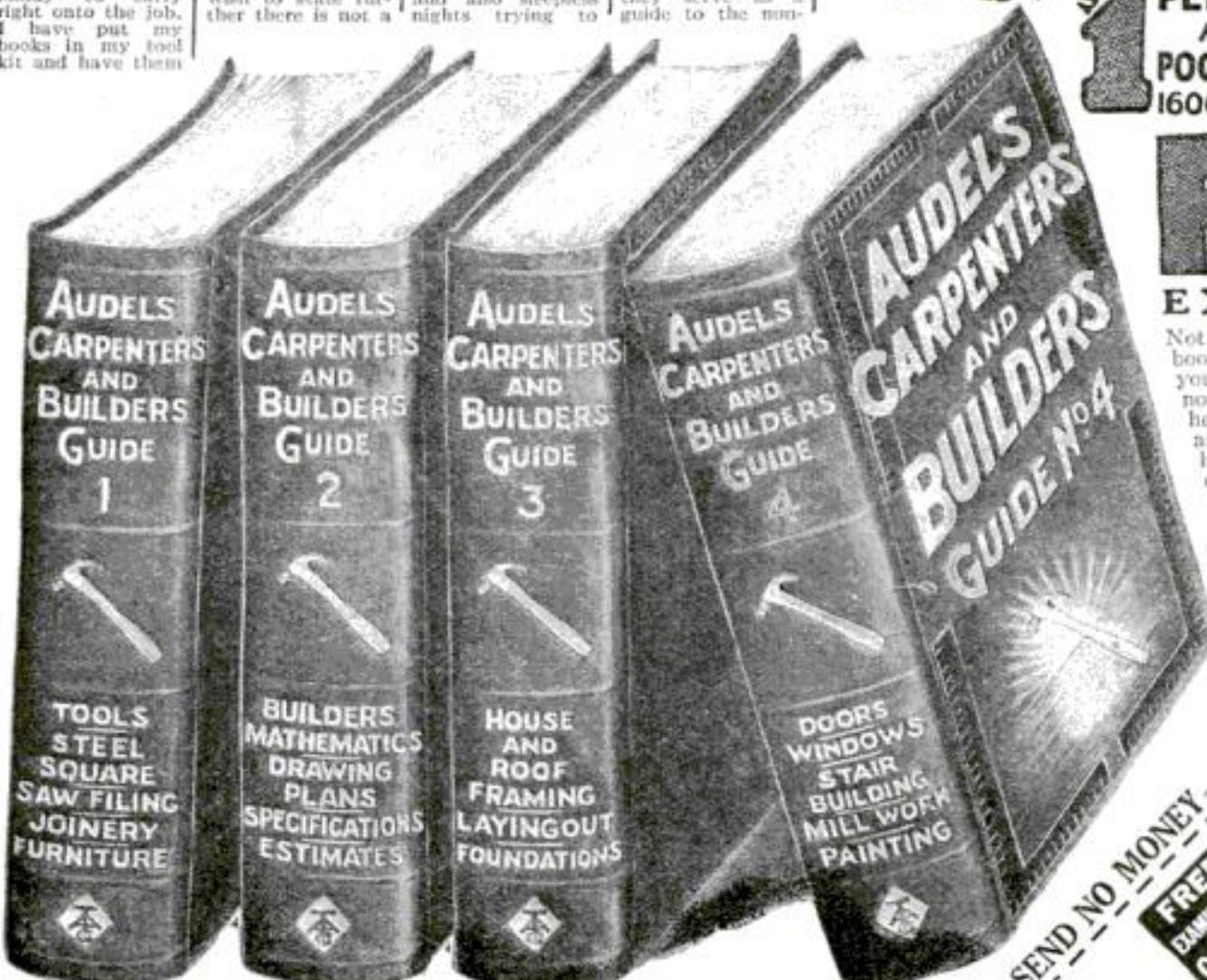
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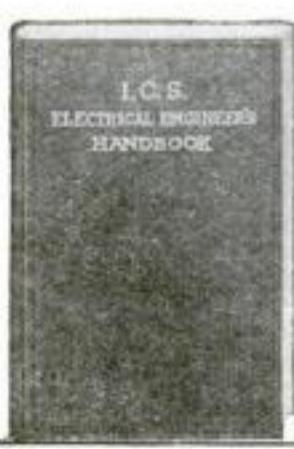


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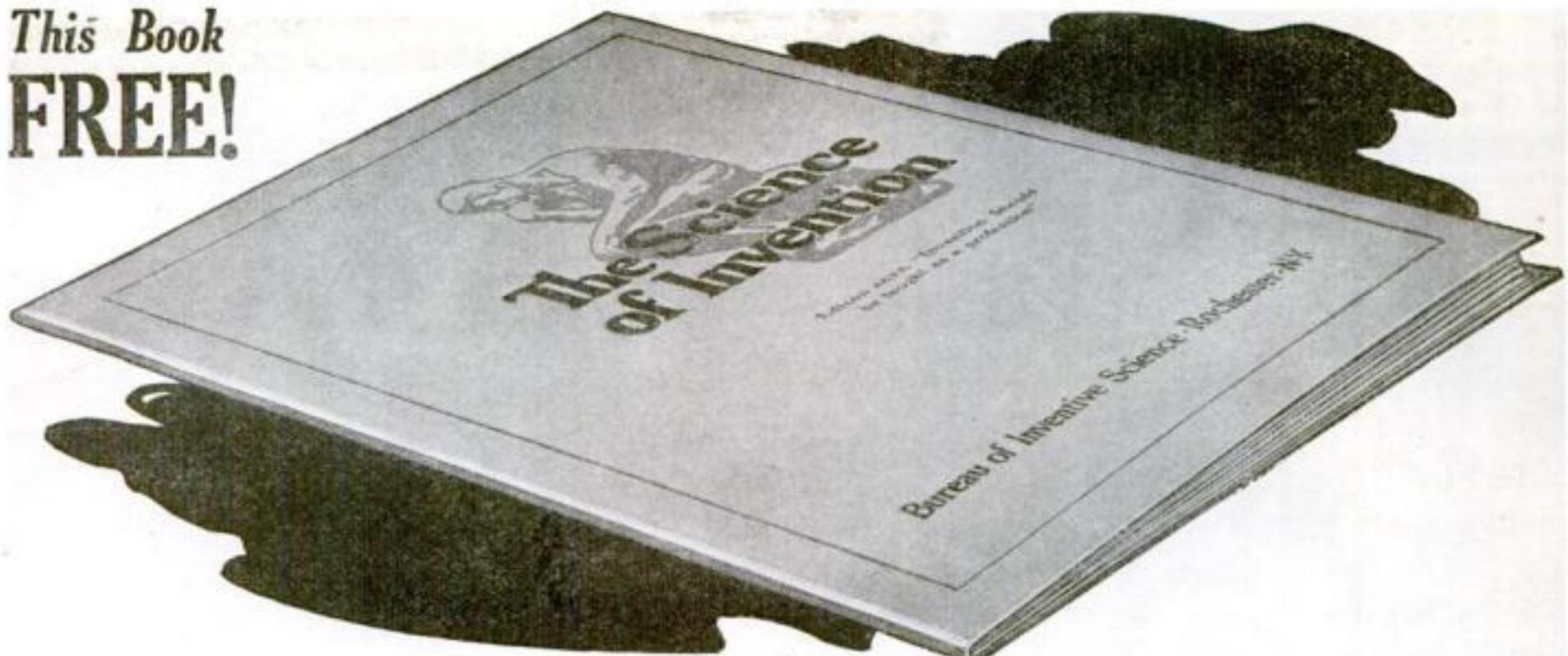
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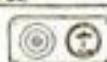


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ORANGEADE, in powder—just add cold water—most delicious drink you ever tasted. Fine for home, parties, picnics, dances, etc. Start in this business—big money easily made. Send dime for ten glass package postpaid. 7 kinds, Cherry, Grape, Lemon, Strawberry, etc., 70 glasses only 50c, postpaid. Chas. S. Morrissey Co., 4417 Madison St., Chicago.

PROTECTS your home and property, the Junior Electric Burglar Alarm, attached to your Doors and Windows, complete with directions for installing. Only \$7.50. Send \$1.00 with order; balance C. O. D. Agents wanted. Warco Alarm, Box 664, Chicago.

AGENTS! At last a perfect Knife Sharpener. A sure seller and a money-maker. Retails \$1.00, 100% profit. Guaranteed a lifetime. Write, Conaway & Conaway, Dept. (C) Champaign, Ill.

ONLY one sale a day means \$200 per month! Five sales \$1,000 per month. Marvelous new adding machine. Retails \$15.00. Work equals \$350 machine. Adds, subtracts, multiplies, divides automatically. Speedy, accurate, durable, handsome. Five year guarantee. Offices, stores, factories, garages buy one to dozen. A fortune for live agents. Write quick for protected territory and free trial offer. Lightning Calculator Co., Dept. F, Grand Rapids, Michigan.

AGENTS make 500% profit handling auto monograms, new pictures, window letters, transfer flags, novelty signs. Catalog free. Hinton Co., Dept. 125, 1153 No. Wells, Chicago, Ill.

CHEAPEST self-wringing mop made. Big Seller. 100% profit. Eastway Company, 405 St. Paul, Baltimore, Md.

EVERY house a sale; Fast sellers; Particulars. Helmers Company, Desk No. 12, Hoboken, N. J.

50% PROFIT selling name cards, penknives, stationery, catalog. Wolf Labels, 1309 E. Leveck Street, Philadelphia.

31 BILLION, 650 million marks, real German currency for only \$1.00. Wholesale prices with order only. Atlantic Co., 1209 Beach Ave., Bronx, New York.

MAKE \$25 to \$50 week representing Clow's Famous Philadelphia Hosiery, direct from mill—for men, women, children. Every pair guaranteed. Prices that win. Free book "How to Start" tells the story. George Clow's Company, Desk 24, Philadelphia, Pennsylvania.

\$10 to \$25 Daily. No Investment. Free outfit. Best values. Largest commissions. World Raincoat Company, 659-S Morris Park Ave., New York.

AGENTS wanted—Don't get pinched. Put Liteout detectors on your car. Tells you when your light is out. Sample pair postpaid. \$1. Exclusive territory. World Mfg. Co., 1522 8th St., Des Moines, Iowa.

MAKE \$17 day—Finest extracts, food products, toilet preparations, household necessities. Credit; sample case free. Write for amazing offer. Perkins Products, B-26, Hastings, Nebr.

WE start you without a dollar. Soaps, extracts, perfumes, toilet goods. Experience unnecessary. Carnation Co., Dept. 21, St. Louis.

More Money Making Opportunities
on pages 4 to 17

**Earn \$75 to \$200 a Week**

That's the money for you! And you can have it! Why not? The jobs are open—they're calling for trained men to fill them—all you need to walk off with a \$75 to \$200 a week job is training. Get it! Here's how:—Give us an hour a day, spare time, and we'll quickly put you across to big success in the Automotive Game. We've done it for hundreds of fellows just like you—men with perhaps less education, brains and ability. These fellows are holding down big money jobs—running their own business—making something out of themselves—YOU can do it too! For the sake of your dollars and cents future, send the coupon today, and find out just what we can do for you.

Learn at Home From 20 Master Experts

Here's a course written not by one man, with the narrow, one-man viewpoint, but by 20 of the country's brainiest, most successful Automotive Experts. Fits you for a dozen big pay jobs. Shows how to start and build a successful business of your own. Learn it all at home, in spare time, under a money back guarantee of results and satisfaction.

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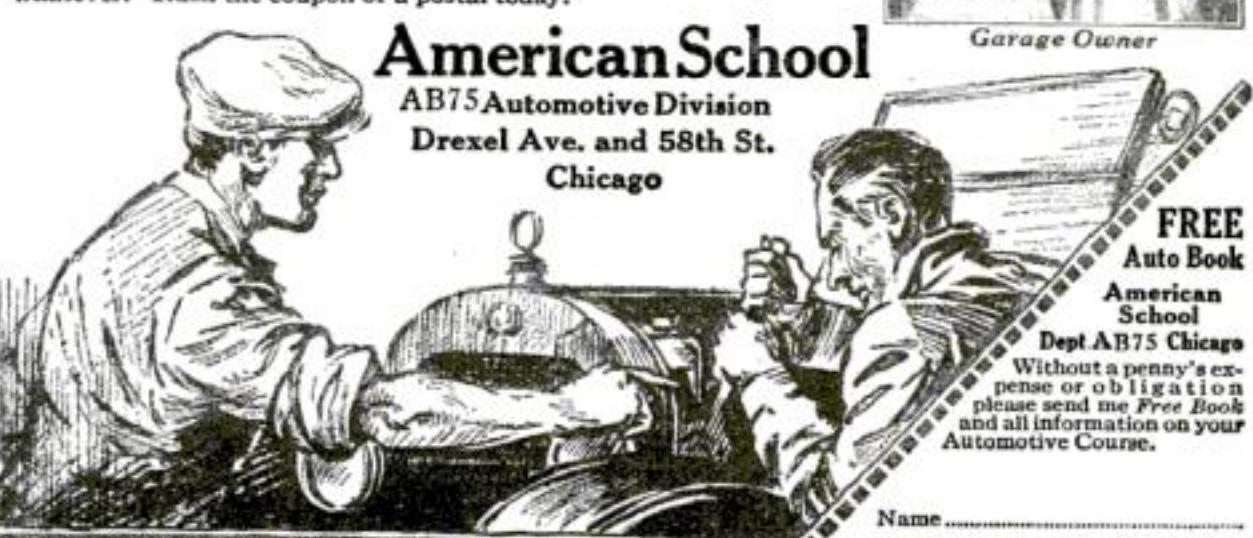
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EVERYONE admires and wants to dance with the person who knows the latest steps. There is no need of being a wallflower! By my remarkable new easy method, anyone can learn the newest dances at home in a few hours. Much less expensive than from a personal teacher. No music or partner needed. So simple even a child can learn quickly. 126,000 have learned dancing by mail. Your own success is guaranteed.

To prove I can quickly make you an accomplished dancer, I will send you **FREE** in plain cover, a lesson in Fox Trot. Secret of Leading, How to Gain Confidence, How to follow and to Avoid Embarrassing Mistakes. To help pay the cost of handling, mailing, etc., send 25c. Learn in private, surprise your friends. Act now. Be a good dancer soon!

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DECIDE THIS QUESTION ONCE FOR ALL!
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Here's the quickest way to big pay work. Taken only an hour a day of your spare time for a few months. Robinson jumped from \$20 to \$100 a week in six months. You, too, can boss Auto Job. I'll show you how. **Learn at home. Learn by "Job-Way" Plan.** Send for big illustrated book, explaining "Job-Way" course. Tells about money back guarantee, free tools offer. Low price and easy terms. Book is free. No obligation. A postal will do. Write NOW.

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Clarinet	Composition
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IN FEW MONTHS

You can learn by playing actual selections instead of tiresome exercises and eliminate endless hours of practice. A new simplified method of teaching reduces all music to its simplest possible form. We teach you in your own home by note. No numbers or "trick stuff." So simple that young and old find it easy to play with amazing skill. All intricate "mysteries" of music eliminated. Thousands have learned this splendid quick way. Surprise everyone and become popular, practically

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offers this wonderful musical opportunity. Send for them today. You'll be astounded, thrilled, fascinated, at this easy, rapid way to become a veritable master of your favorite instrument. Name the instrument you are particularly interested in. Special reduced price if you write at once.

U. S. SCHOOL OF MUSIC, 87 Brunswick Bldg., New York City

Learn Cartooning

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from the school that has trained so many successful cartoonists of today earning from \$50 to \$200 and more a week. The Landon Picture Chart Method of teaching makes original drawing easy to learn. Send 6c in stamps for full information and chart to test your ability. Also state age.

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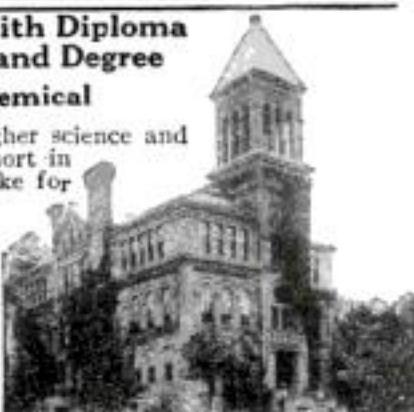
Compact courses of essentials. Richer in higher mathematics, higher science and mechanical drawing; also shop and field work. Planned for those short in time and money, but strong in purpose. Courses distinguished alike for what is embraced and what is omitted. Adapted to

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Indispensable preliminary work provided for students with only elementary school education. Modern shops, Laboratories, Library, Apparatus and Machinery. If interested, be sure to write. Expenses low. For catalog address

TRI-STATE COLLEGE OF ENGINEERING, Box P-7, Angola, Ind.



Money Making Opportunities

AGENTS AND SALESMEN WANTED

MAKE \$100 weekly in spare time. Sell what the public wants—long distance radio receiving sets. Two sales weekly pays \$100 profit. No big investment, no canvassing. Sharpe of Colorado made \$955 in one month. Representatives wanted at once. This plan is sweeping the country—write today before your county is gone. Osarks, 803 Washington Blvd., Chicago.

PATENTED Cigar Lighters with Glass Advertising Front. Also Electric Cigar Moistener. Wonderful Sellers. No Competition. Big Steady Profits. Proof, Costs, Sales Plan Free. Drake Mfg. Co., Dept. P., Milwaukee, Wis.

MAKE \$8 a day selling Imported Bamboo Fountain Pen. Whirlwind seller. Free sample. Mohler, Dept. 6, 416 S. Dearborn, Chicago.

NEWEST Invention! Improved Pocket Calculating Machine. Does work of expensive machine. \$15.00. Agents: Big Profits! Schultheis, 1065-C Bergen Street, Brooklyn, N. Y.

SELL necessities. Everybody needs and buys the "Business Guide." Bryant cleared \$800 in July. Send for sample. It's free. Nichols Company, Box 1B, Naperville, Illinois.

EARN \$10 daily silvering mirrors, plating and refinishing metal ware, headlight chandeliers, bedsteads. Outfits furnished. F. Decie Laboratories, 1133 Broadway, New York.

GET our free sample case toilet articles, perfumes and specialties. Wonderfully profitable. La Derma Co., Dept. F, St. Louis, Missouri.

AGENTS: Big profits. Best and cheapest window letters made. Easily applied. Dime brings five samples. Particulars free. Staibrite Company, 1115 Second Avenue, New York.

ARE you old at forty? See our advertisement on page 92 of this issue. The Electro Thermal Company, 4035 Main St., Steubenville, Ohio.

AGENTS—\$75.00 Weekly Selling Nustile Guaranteed Hosiery. Your pay daily. You write orders, we deliver and collect. Special monthly bonus. Sample outfit furnished. Nustile Hosiery Mills, Dept. 400, Philadelphia, Penna.

SALES MEN—Sell "Amenz" radioux shirts; guaranteed to wear one year. Very liberal commissions. Get our proposition first. Menzin Shirt Co., 479 East Tremont Ave., New York.

BIG money and fast sales. Every owner buys gold initials for his auto. You charge \$1.50; make \$1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 47, East Orange, New Jersey.

AGENTS: Bill Omeis, just an ordinary fellow, made over \$5000.00 during 1923 selling our \$1.50 kitchen specialty. He is now a district manager. We are offering you the same proposition—an opportunity as big as you want to make it. You can do what Omeis did. Write today, M. H. Tyler Mfg. Co., Dept. P-1, Muncie, Ind.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager, Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

AGENTS—Household necessity, sells quickly. Large profits. Square deal. Premier Mfg. Company, Dept. 5, Detroit, Mich.

\$10.00 DAILY easily made selling Needle Cases; retails 25c. Send 10c for sample. Mail Order House, Wilmerding, Penna.

EVERY house a sale; Fast sellers; Particulars. Helmers Company, Desk No. 12, Hoboken, N. J.

POLMET—The Wonderful Polishing Cloth that cleans all metals without liquid, paste or powder. Approved by "Good Housekeeping" and "Modern Priscilla"—sells fast at 25c. Sample Free. F. C. Gale, 15 Edinboro St., Boston.

FORMULAS. Processes, Trade-Secrets—Different, dependable, profitable. Catalog free. C. Thaxby Co., Washington, D. C.

\$100 WEEKLY selling One-Minute Tire Changer to car owners, garages, tire stores, bus lines, etc. Simple—sure—speedy—sells on sight. Big sales records. Makes wonderful demonstration. Exclusive. We help you start. Write Dept. P, R-M Mfg. Co., 14 Riegel St., Dayton, Ohio.

WONDERFUL discovery. Charges batteries in ten minutes. Gallon free to agents. Radiolite Co., St. Paul, Minn.

FREE Copy—Big Fun Magazine. Representatives wanted. Fin-Ko, 944-P Clark, Toledo, O.

CAN you sell to colored people? Write Stratene Co., Dept. 100, 2500 Second Ave., Birmingham, Alabama.

SALES MEN sell sales and order books, auto, reg. rolls and bill ledgers. Large demand. Liberal commission. Wirth Sales Book Co., Dept. PS, Chicago.

MEN and women representatives wanted to take orders for Annie Blain flavoring extracts in every locality, wholesale and retail; new selling system; free samples to public and other unique methods. Address Annie Blain Co., New Brunswick, N. J.

AGENTS—Make big money selling Horsey-Bassett Silk-Like Rubber Aprons and Specialties. Finest on market. New styles, new colors, new selling plan. Your profits in advance. \$15 a day easy. You show samples and mail us orders. We deliver and collect. Send name and address for sample apron and selling outfit, C.O.D. 75c. Become our District Manager. Address The Horsey-Bassett Co., Inc., Dept. PS-7, Cristfield, Maryland.

MEN only. Sell new novelty. Sample 25 cents. Howard Eddy, Meriden, Connecticut.

EASY work, big profits selling automobile spring lubricators. Automatic Spring Oiler Co., Drawer 18, Corona, New York.

THE Greatest Money Maker in years for Agents. Manufacture and sell your own guaranteed products. Mystine Products Co., 3006 Fifteenth St., Everett, Wash.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 225 West 39th Street, New York.

DUSTLESS Sponge Cloth. New Invention. (1) Rub—Dusts, Cleans and Polishes Automobiles, Furniture, Pianos. Retails 50c.—Costs 16c. Sample Free. Nulife (H) Sponge, Hartford, Conn.

**More Money Making Opportunities
on pages 4 to 17**

Money Making Opportunities**AGENTS AND SALESMEN WANTED**

CAN you sell Ford size tires at \$3.50 each? Write for plan. Details free. American Accessories Co., Dept. 179, Cincinnati, Ohio.

OVER 250% PROFIT: Salesmen—Crew Managers—Agents: Large profits, easy sales, satisfied customers are prime factors in selling. Midwest Household Necessities embrace these factors. Particulars free. Midwest Drug Co., 190 East Naghten St., Columbus, Ohio.

A DIFFERENT OIL-GAS Burner. Separate flame-control valve, bronze generator. No noise, no carbon. Sells to tourists, campers, farmers, hot-dog stands, anywhere. Install in any stove. 87% profit. Write for agency. E. R. Caldwell & Son, Syracuse, N. Y.

A BUSINESS OF YOUR OWN. Make Sparkling Glass Name and Number Plates, Medallions, Checkerboards, Signs. Big Illustrated Book Free. E. Palmer, 513 Wooster, O.

AGENTS—A new copyright booklet of scientific secrets and original tricks, etc., 25cts. 12 for \$1.00. Pentland Service, One Thames Ave., Norwalk, Conn.

MEN and women make money easy selling Perfection Steam Pressure Cookers. Wonderful new invention. Cooks in one-third the time—makes toughest meat tender. Saves time—saves money. Write Jubilee Mfg. Co., 64 Sta. C, Omaha, Nebraska.

HERE they are: Fifty fast sellers everybody needs and buys. \$50 weekly easily made. B. & G. Rubber Co., Dept. 594, Pittsburgh, Pa.

BUILD permanent business. Men's, Women's, Children's guaranteed shoes direct to wearer. A. P. Condon, Sales Manager Allen Shoe Co., 110 Summer, Boston.

STOP Right Here. Make real money this summer. Week's salary often made on one sale. Look at our salesmen's monthly averages—N. Y. man, \$600.00; N. Dakota man, \$500.00; Ind. man, \$750.00, and so on. You call on business men only. Introduce entirely new proposition. No competition. Rich territory open. No collections, No deliveries. You take orders—we do the rest. Write—get complete dope. National Advertising Service, Inc., P. O. Box 74, LaGrange, Ind.

BEST proposition in the Specialty field. Perry Lykold Paintings, Photo Medallions, and Novelties have no equal. Every interview means a sale. 600% profit. Write for details. Perry Photo Novelty Corporation, Sect. PS7, 360 Bowery, New York.

WE Start You in Business—No Capital Required. Monogramming Automobiles, Luggage, Windows, Wagons. Six Initials Bring \$1.50—Costs You Only 6¢. Transferred as Easy as Applying Stamps on Envelopes. No License, No Experience. "Samples Free." Nullife (H) Monogram Works, Hartford, Conn.

BIG Money and Fast Sales—Everybody—Everywhere Everywhere finds hundreds of uses for Darn E-Z Universal Fabric Cement—Good exclusive territory still open. Darn E-Z Laboratories, Dayton, Ohio, Dept. P. M.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

AGENTS—90¢ an hour to advertise and distribute samples to consumer. Write quick for territory and particulars. American Products Co., 1805 American Bldg., Cincinnati, O.

\$30.00 DAILY taking orders. Beautiful guaranteed embroidered (two colors) washable table cloth \$2.95. Big commission. We deliver. Atlas Linen Co., 600 Blue Island Ave., Factory 17, Chicago.

AGENTS—\$11.80 daily in advance; (send for sworn proof). Introducing New Insured Hosiery—47 styles, 35 colors; guaranteed seven months; summer line now ready; no capital or experience required; you simply take orders; we deliver and collect (or you can deliver, suit yourself); credit given; pay you daily; monthly bonus besides; we furnish samples; spare time will do. Mac-O-Chee Textile Company, Room 1527, Cincinnati, Ohio.

AUTO Owners! Get your tires Free! Be our Factory Agent! Big spare tire money-maker! Sample tires furnished. No capital or experience needed. Write today. Armour Tire & Rubber Co., Desk 807-A, Dayton, Ohio.

SELL Pearl Necklaces. 500% profit. Everybody wants one. Easy to sell. Write for rock-bottom prices. Star Import Company, 63 Second Avenue, New York.

RETIREE in five years, selling our Super 1-2-3 Ball Gum Machine Deals. Six balls for three cents, 100% profit. Cuts furnished. Purity Gum Co., 273-20th St., Milwaukee, Wis.

\$20,000.00 YEARLY. State Distributor. Amazing newly invented Pricing System, retails \$4.90 only. No competition. Tremendous demand!! Millen Mfg. Dept. T, Colonial Bldg., Boston, Mass.

GO into business for yourself. Make money marketing proprietary specialties under your own labels. We furnish everything and show you how. Booklet free. National Scientific Laboratories, 224 Monroe, Richmond, Virginia.

SPARE Time Selling Records. Everybody has a phonograph nowadays. Capital or experience unnecessary. Radex Department, 508 Columbia Road, Boston.

STATE Manager. Envelope Sealer Seals 3500 envelopes hour. Amazing invention! No competition. Retails \$5. only. \$20,000.00 yearly. Red-E Co., Dept. F, 100 Boylston, Boston, Mass.

ASTOUNDING invention. Winterburn makes 41.4 miles per gallon. Fords use kerosene. Big profit. Weeks, 1304-1119, Fondulac, Milwaukee, Wis.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager, Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

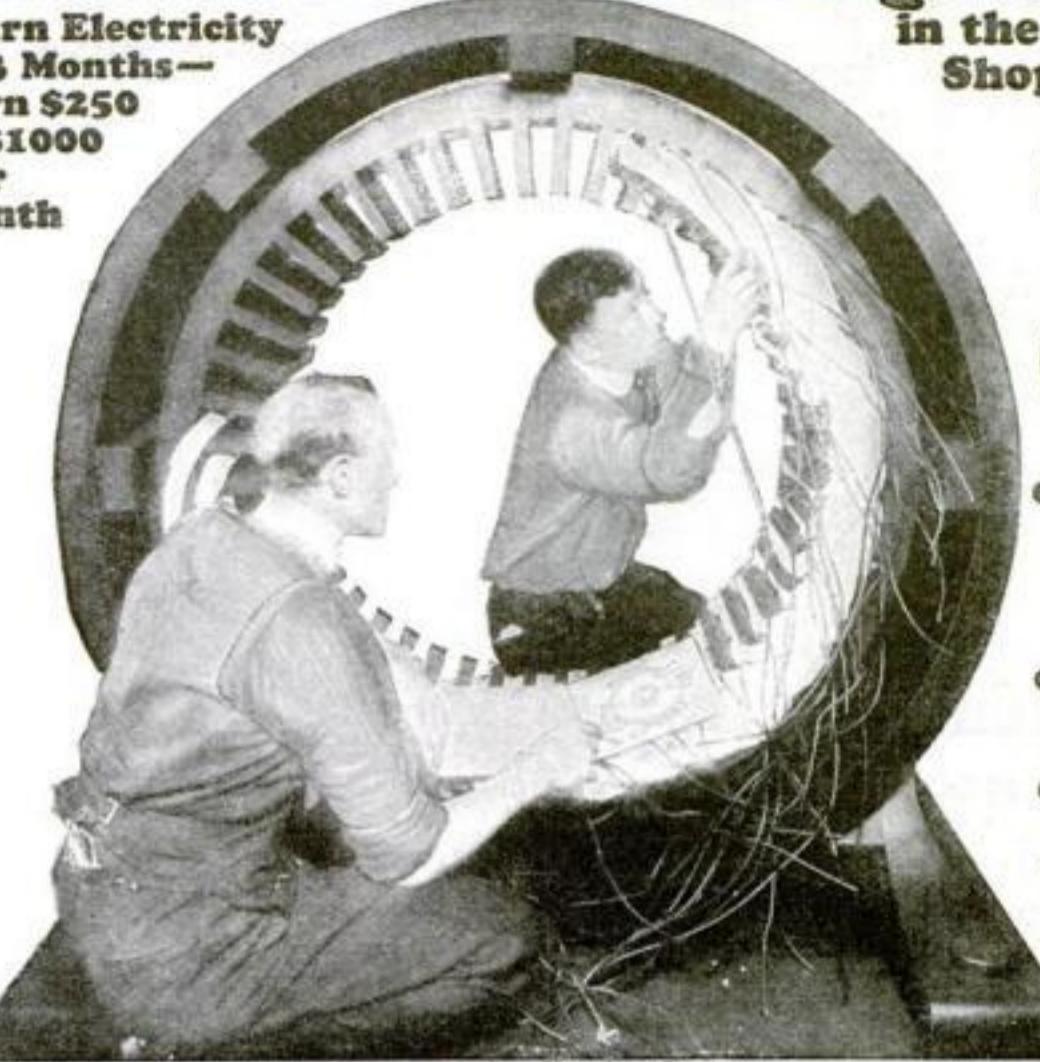
RUMMAGE. Sales make \$50.00 daily. Offer wonderful values. We start you. "Wholesale Distributors," Dept. 34 609 Division Street, Chicago.

NEW, quick money-maker, "Old Master" auto enameling outfit; "Paint Car Today, Drive it Tomorrow," easy to apply, gives wonderful, glossy, factory-like smooth, tough finish; enormous demand everywhere; big season now on; exclusive territory; liberal profit; \$100 weekly easy. Akron Paint Products Co., Dept. 72, Akron, O.

**More Money Making Opportunities
on pages 4 to 17**

Be a BIG PAY Expert!

**Learn Electricity
in 3 Months—
Earn \$250
to \$1000
per
Month**



**in the Great
Shops of**

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Make this the most profitable and enjoyable summer of your life. Come to Chicago, the greatest summer resort city in the country on beautiful Lake Michigan, and greatest electrical center in the world. We pay your railroad fare from any place in United States. See the country at our expense. Become a skilled electrical expert in great shops of Coyne.

Complete Electrical Training in 3 Months

Not a correspondence course—no books or useless theory—everything is practical. You are trained on thousands of dollars worth of electrical equipment. Everything from door bells to power plants. You work on motors, generators, house wiring, autos, batteries, radio, switchboards, power plants—everything to make you an expert ready to step

right into a position paying from \$50 to \$250 a week. A Coyne trained man is trained completely. He can take his place anywhere in the electrical world. Auto ignition and battery experts make from \$3,000 to \$20,000 a year. Hundreds of our graduates are making big money and you can do the same if you grasp this opportunity.

Great Summer Resort City

Chicago, on beautiful Lake Michigan, is the Nation's summer playground. Free bathing beaches, beautiful parks, excursion boats and the great Municipal pier, zoos, ball parks. Coyne is near the lake and bathing beaches.

**FREE Railroad Fare to Chicago
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This is the greatest offer ever made by a school and it is for a limited time. Don't delay a single minute. Send the coupon in right away for our big free catalogue and full particulars of this wonderful offer. Act now! We pay your railroad fare.

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LEARN ENGINEERING

Great Demand for Practical-Technical Engineers. Big Salaries. Wonderful Opportunities. Thousands of our graduates holding responsible high-salaried positions. Practical-Technical Courses from 3 Months to 3 Years in Electrical and Mechanical Engineering. Simple and Condensed Method. Faculty of Trained Experts. New Building. Extensively Equipped Laboratories and Shops. Department of Architecture. Structural and Mechanical Drafting. Degrees Awarded. Positions Secured. Day and Night Sessions. Summer School Now Going on. 22nd Year Begins Sept. 17. Write for Catalog A.

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**\$60
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WRITING
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**BE BOSS OF OWN BUSINESS!
DON'T WORK FOR OTHERS!**

Learn to Make Show Cards—by Miller Mail Method in 60 days—no experience needed. We establish you in your own shop, any locality, worth \$50 weekly, up; furnish all material and plan to secure orders from local merchants to do right at home, evenings, if desired. Get into this fascinating, easily learned, profitable business. Cost low—terms easy. Illustrated matter and terms FREE.

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Become a recognized radio expert. Trained men in urgent demand as broadcasting and ship operators, radio salesmen, engineers, demonstrators, etc. Hundreds of big pay positions now open. No previous training necessary. We train you in theory and practice, receiving set parts and diagrams for practical work at home furnished free. First school to teach radio by mail. Established 1914. Thousands of successful graduates. Get facts and details of special tuition offer from Free Book "Rich Rewards in Radio." Write today. State age.

National Radio Institute, Dept. 12GA, Washington, D. C.

\$20⁰⁰aWeek\$100⁰⁰aWeek

This Man Wouldn't Stay Down

He was putting in long hours at unskilled work. His small pay scarcely lasted from week to week.

He saw other men promoted. Then he learned the *reason*. They had special training. He made up his mind to get that kind of training.

He sent to Scranton a coupon like the one below. That was his first step upward.

The reward was not long coming—an increase in salary. Then he was made Foreman. Now he is Superintendent.

It just shows what a man with ambition can do!

What about you! You don't have to stay down. You can climb to the position you want in the work you like best.

The way to do it is easy—without obligating yourself in any way, mark and mail this coupon.

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Box 7696-C, Scranton, Penna.

Without cost or obligation on my part, please tell me how I can qualify for the position or in the subject before which I have marked an X:

BUSINESS TRAINING COURSES

- Business Management
- Industrial Management
- Personnel Organization
- Traffic Management
- Business Law
- Banking and Banking Law
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- Nicholson Cost Accounting
- Bookkeeping
- Private Secretary
- Spanish French
- Salesmanship
- Advertising
- Better Letters
- Show Card Lettering
- Stenography and Typing
- Business English
- Civil Service
- Railway Mail Clerk
- Common School Subjects
- High School Subjects
- Illustrating

TECHNICAL AND INDUSTRIAL COURSES

- Electrical Engineering
- Electric Lighting
- Mechanical Engineer
- Mechanical Draftsman
- Machine Shop Practice
- Railroad Positions
- Gas Engine Operating
- Civil Engineer
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- Metallurgy Mining
- Steam Engineering Radio
- Architect
- Architects' Blue Prints
- Contractor and Builder
- Architectural Drafter
- Concrete Builder
- Structural Engineer
- Chemistry Pharmacy
- Automobile Work
- Airplane Engines
- Agriculture and Poultry
- Mathematics

Name..... Street..... Address..... State..... 3-6-24

Occupation..... Persons residing in Canada should send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

Money Making Opportunities

HELP WANTED

BE a detective. Excellent opportunity to earn big money, travel, thousands of dollars offered in rewards. Established 1909. Particulars free. Write to C. T. Ludwig, 424 Westover Bldg., Kansas City, Mo.

SILVERING Mirrors, French plate. Easily learned; immense profits. Plans free. Wear Mirror Works, Excelsior Springs, Mo.

OUR genuine gold window sign letters are an excellent money-making proposition for handy men. Shann Sign System, East Bethune Avenue, Detroit, Michigan.

EMPLOYMENT in South America. We furnish classified lists of 350 employers for \$1. South America Information Bureau, Portland, Oregon.

ALL men, women, boys, girls, 17 to 65, willing to accept Government Positions, \$117-\$250, traveling or stationary, write Mr. Ozment, 295, St. Louis, Mo., immediately.

BARN \$10.00 to \$35.00 weekly mailing circulars at home. Outfit and instructions 25 cents. Jamorris, 2305 Gratz, Philadelphia, Pa.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 225 West 39th Street, New York.

DETECTIVES needed everywhere; cities, towns. Particulars free. Write National Detective System, 188 East 79th, New York.

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on pages 4 to 17



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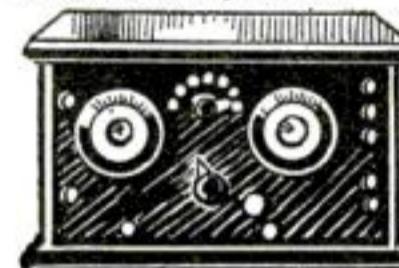
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How to Double Your Efficiency	
VISUALIZATION—How to Make Your Dreams Come True	
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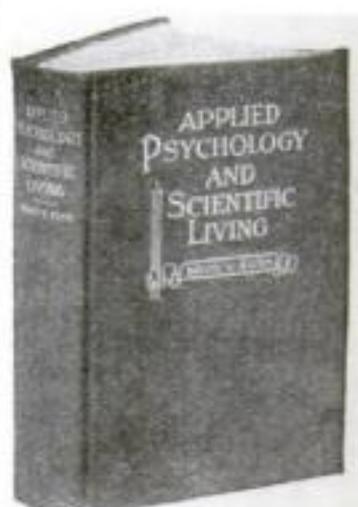


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Tests of a Radio Set in Popular Science Institute of Standards Laboratory where, by means of a miniature transmitter, the action of a set can be accurately measured

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1. *The external appearance*
2. *Workmanship*
3. *Sensitivity*
4. *Selectivity*
5. *Amount of amplification*
6. *Wave-length range*
7. *Quality of reproduction*
8. *Operating characteristics*

When we first receive a set for test in our laboratories we examine it to determine that it meets the requirements of the average user. Each piece of apparatus is inspected to determine that it is constructed properly mechanically, and is built substantially; that all soldering is perfectly done and that it will give the maximum electrical efficiency.

Then laboratory tests are made. Sensitivity is determined by means of an oscillator or a miniature transmitter, which has been adjusted previously for a predetermined output, and then started and placed so that the antennae coils of the receiving and transmitting sets are in a coupling position. The signal strength at the end of the detector tube is measured. By varying the transmitter output of the oscillator we can imitate the actual conditions found with stations broadcasting at different power outputs. By vary-

ing the coupling we can approximate the strength to be received at different distances. Analysis of readings thus obtained gives a determination of the sensitivity and signal strength locally and for the distance.

NEXT is a test for selectivity. With the same set-up as in determining sensitivity, we can tune in on the oscillator which has been started with a predetermined coupling and transmitter output. The signal current is measured on the detector. Then the transmitter is detuned until the signal current is reduced to about one-half. By use of formulas, selectivity of the set is determined in terms of the frequency change. Thus the less the change is required in detuning the transmitter, the more selective is the set.

The amount of amplification is determined by using the same set-up but with modulated audio-frequency. The amount of amplification is measured by comparing the signal strength with the amplifier and the signal strength using the detector tube only. In this way we can determine whether or not a set gives a sufficient amount of amplification. After this a test of wave-length range is made. A measure of the range of the set as a receiver, its maximum and minimum range of wave length, is made. To be an efficient receiver, it must, of course, be able to cover the usual wave lengths used by the different broadcasting stations.

The quality of reproduction is another important factor. The set is operated under average conditions and a determination of the quality of reproduction is made. The final test of the series is that of operating characteristics. A determination of the ease of tuning is made. Then, too, there must be a sufficient independence of tuning. It must be possible to tune in accurately; for this you require fine control. Finally, the set must remain put after it is adjusted.

A RADIO set must pass the rigid tests outlined above, to receive the Popular Science Institute of Standards approval.

Readers are urged to make full use of the service of the Popular Science Institute of Standards, as through the careful testing of a staff of competent engineers the Popular Science Institute of Standards assures every reader that the Radio Products displayed in our columns are of good value and will under normal and proper use give absolute satisfaction.

Test of radio apparatus is only one of the functions of the Popular Science Institute of Standards. In the next issue of Popular Science Monthly we will tell how we protect you in your purchases of tools.

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Popular Science Monthly guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in Popular Science Monthly may expect that these products will give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by Popular Science Monthly.

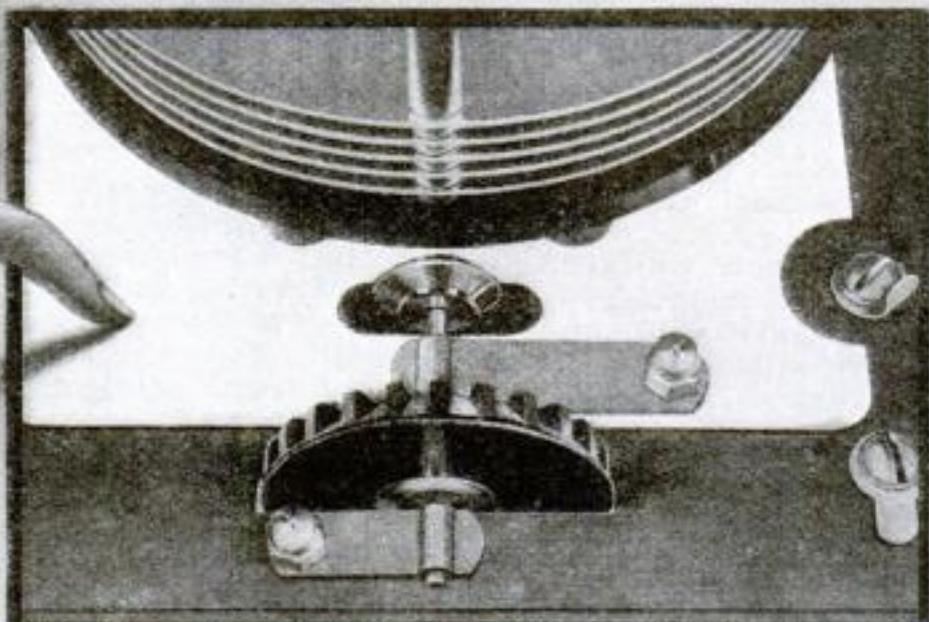
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—Lao Tzu

The wise buyer of a radio receiver is not misled, he looks inside the cabinet.

Doctor Mu



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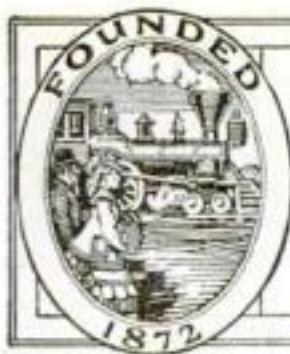
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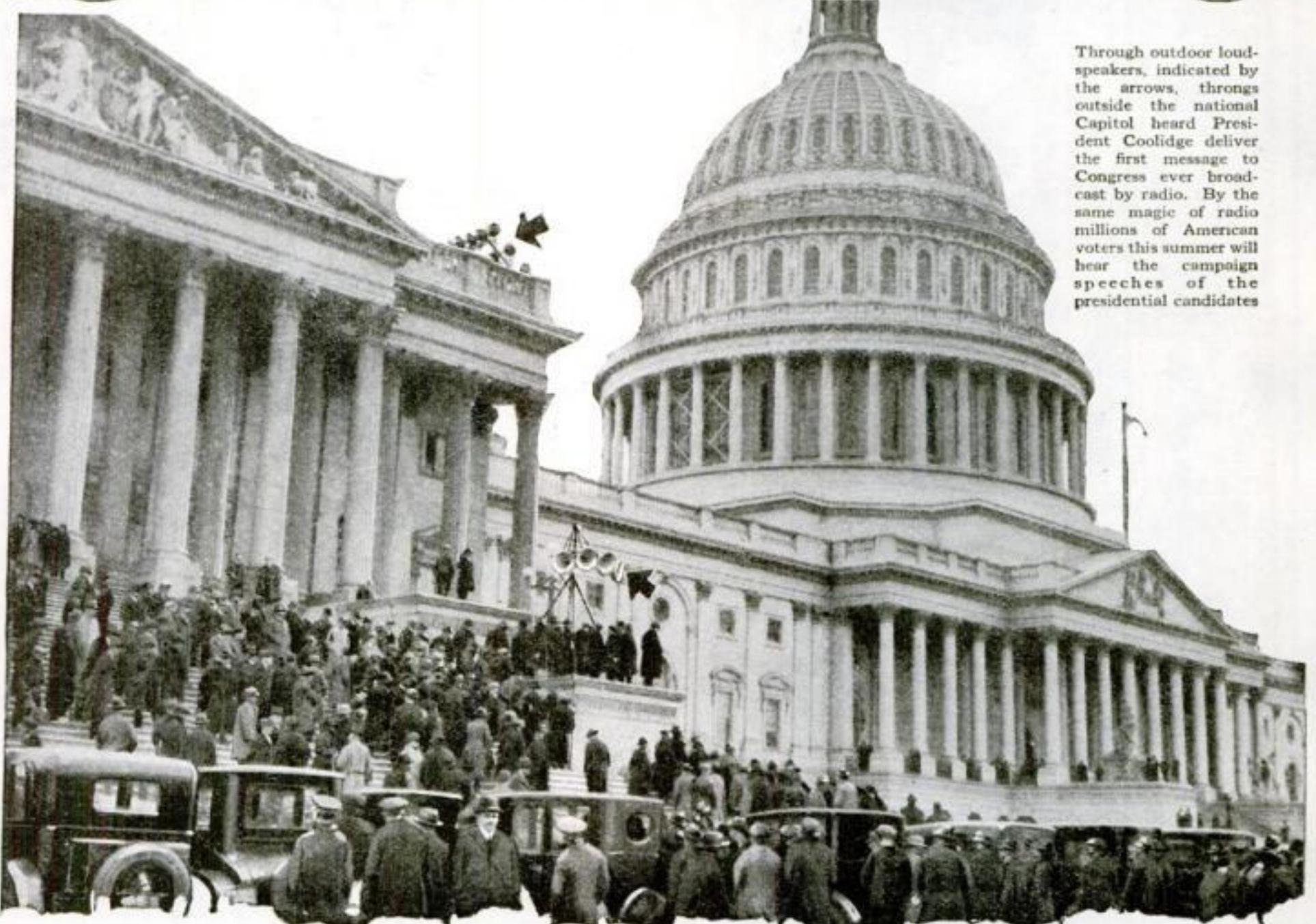
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POPULAR SCIENCE MONTHLY

SUMNER N. BLOSSOM, Editor

July, 1924



Through outdoor loud-speakers, indicated by the arrows, throngs outside the national Capitol heard President Coolidge deliver the first message to Congress ever broadcast by radio. By the same magic of radio millions of American voters this summer will hear the campaign speeches of the presidential candidates

Radio's Part in Politics

By Edward G. Lowry

PRESIDENTIAL campaign year 1924 brings with it a brand-new puzzle for the politician. The puzzle is the radio fan. Politics is largely a matter of publicity. Since the 1920 campaign, radio broadcasting has developed into one of the greatest mediums of publicity in the land. Hence the politician's concern.

When those fellow Ohio editors—and publicity experts—Warren G. Harding and James M. Cox ran against each other for the presidency, there were but 15,000 sets in the country. That figure is the estimate of the Department of Commerce radio experts. Today, Secretary Hoover estimates that there are no less than 5,000,000 radio receiving sets in regular use. Since—through loud-speakers and extra head sets—each receiver probably averages at least two listeners, it is probable that some 10,000,000 people hear what the radio waves are carrying each day.

To a political spellbinder, eager to sell

Mr. Lowry is one of America's foremost political writers. Through his close personal contact with the leaders of both the Republican and Democratic organizations, he is able to present here the first comprehensive estimate of the tremendous part radio will play in electing our next President.

his wares, that is an audience such as no man before, even in his wildest dreams, ever hoped to reach. Probably the most ambitious spellbinder this country has ever known is James M. Cox. His campaign in 1920 was a marvel to foe and friend alike. During the last three months of his campaign, Cox traveled more than 10,000 miles in his special car, talking on an average of 10 times daily to audiences ranging from mere handfuls of people to the 30,000 who assembled to hear him on notification day at the Dayton Fair Grounds.

Cox was able to achieve this almost

superhuman task because he was physically stronger than nine out of 10 men of his age; and he was considerably younger than the average presidential campaigner. Also, to keep himself fit, he carried with him his own cook and masseur.

HOW many people heard Mr. Cox? There is no way to ascertain the exact number, but newspaper correspondents who traveled with him once figured that he may have made his voice heard to 1,500,000 at the most. A more conservative estimate would be 1,000,000, or but one-tenth the number the Democratic candidate in 1924 can reach in one evening from his comfortable front porch, if he can arrange for an adequate chain of broadcasting stations to carry his message to the radio fans of the whole country.

Indeed, through the magic of radio, either of this year's candidates, if his line is connected with such a chain of



The corner soapbox—1924 edition. This powerful radio receiver with loud-speaker, mounted on a motor truck, is designed to carry the voice of a distant campaign orator to the street-corner crowds. It may play an important part in this year's presidential campaign

broadcasting stations, can talk through his own home or office telephone to an audience greater possibly than the total number of people who heard the voices of every presidential candidate since the time of Lincoln! Certainly this is a phase of present-day campaigning that can not be overlooked.

OF COURSE, there is the view that Cox in 1924, by his vigorous campaign, made himself known personally to a great number of his fellow citizens. That was an asset worth something, but it is probably offset by the fact that many who rallied to hear his speeches, but who were in the back rows, could not hear his voice. Everybody who tunes in can hear everything that the radio spellbinder has to say. Moreover, as every radio fan knows, when he hears a speech over the radio he is impressed by a certain intimacy, a sense of contact with the speaker. Especially is this true when listening in by headphones, when it seems to the auditor almost as if the orator were addressing his words to him alone.

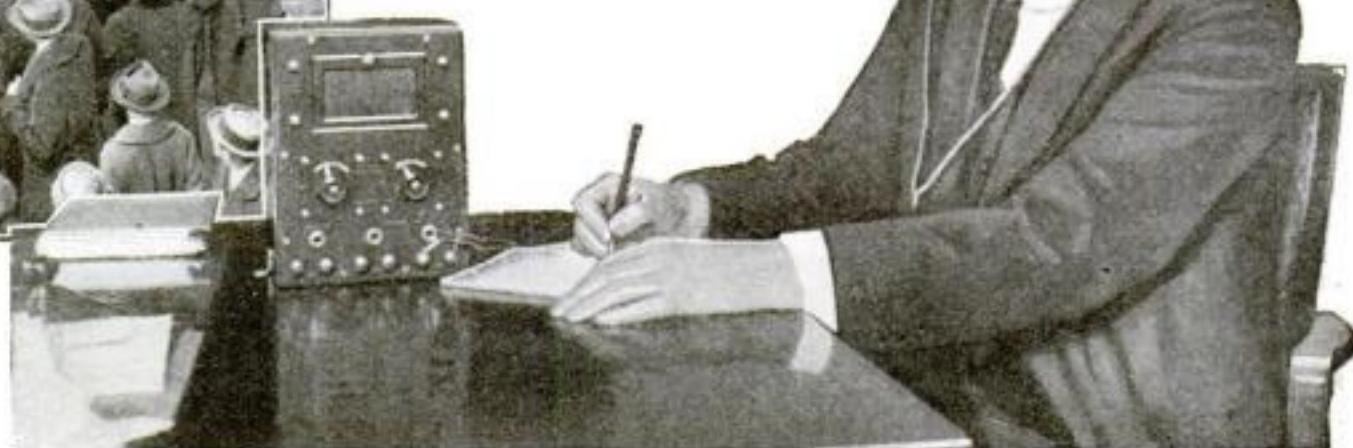
"Let me talk to a man face to face and I will convince him!" public speakers have been declaring for years. And now radio gives them at last an opportunity to make good their boast.

Another thought is that those who turned out to Democratic rallies in the 1920 campaign were Democrats. They would have voted for Cox whether they had heard him or not, for the most part. The candidate who campaigns by radio reaches a mixed audience of Republicans,

Democrats, and independents. It is the latter who turn the tide of a political battle. Regulars vote straight. It doesn't take so terribly many independents to give one candidate or the other a victory. In 1916 it took but 591,385 of them to keep Mr. Hughes out of the White House and to keep Mr. Wilson in.

Some of the thoughts in the minds of national political leaders

Herbert Hoover, Secretary of Commerce, not only is radio dictator of the United States, but is an ardent radio fan as well. He is cited by Mr. Lowry as one of the men who, while not considered good public speakers, have found themselves in demand as radio speakers because of their clearness



country, to see that amplifiers and trunk lines are working right. This service is expensive to the telephone company and the user alike.

IT IS true that the broadcasting companies who work entirely by radio are perfecting a system of re-broadcasting, without the use of the land wires. However, at the present time but one large re-broadcasting station of this sort is in operation, and it appears unlikely that this method will be sufficiently developed to cover the country in the 1924 campaign.

An idea of the arrangements necessary for nation-wide broadcasting may be gleaned from the way the President's recent speech before the Associated Press editors in New York was handled. The President spoke at a luncheon at the Waldorf Hotel. His entire message, and even the side remarks of those near him, the tinkling of ice in the glasses and the rattle of dishes, was heard by radio fans all over the country, for, besides being broadcast direct from New York, the words of the President were carried also over the telephone lines to Washington, Pittsburgh, Kansas City, and Providence to be re-broadcast. It is probable that that speech, delivered to a few score of editors in New York, was heard simultaneously by several million people.

At its present stage of development, radio broadcasting probably lends itself best as an adjunct of a regular political campaign. To use radio, the candidate making a front-porch campaign, as did

RAADIO presents not a few practical problems to the political managers of the Republican and Democratic parties, both of which plan to use radio broadcasting during the campaign. As this was written, the most that either party had done was to arrange for the broadcasting of the speeches, the noise and the other audible features of the conventions, from Cleveland and from New York. The biggest question, cost, did not come up for solution, because the radio companies were eager to broadcast the convention proceedings as fine programs for their audiences.

This means that, whereas the national conventions of 1920 were limited to the lucky 30,000 who were able to get tickets in Chicago and San Francisco, the 1924 conventions were open to all who had the necessary receiving set.

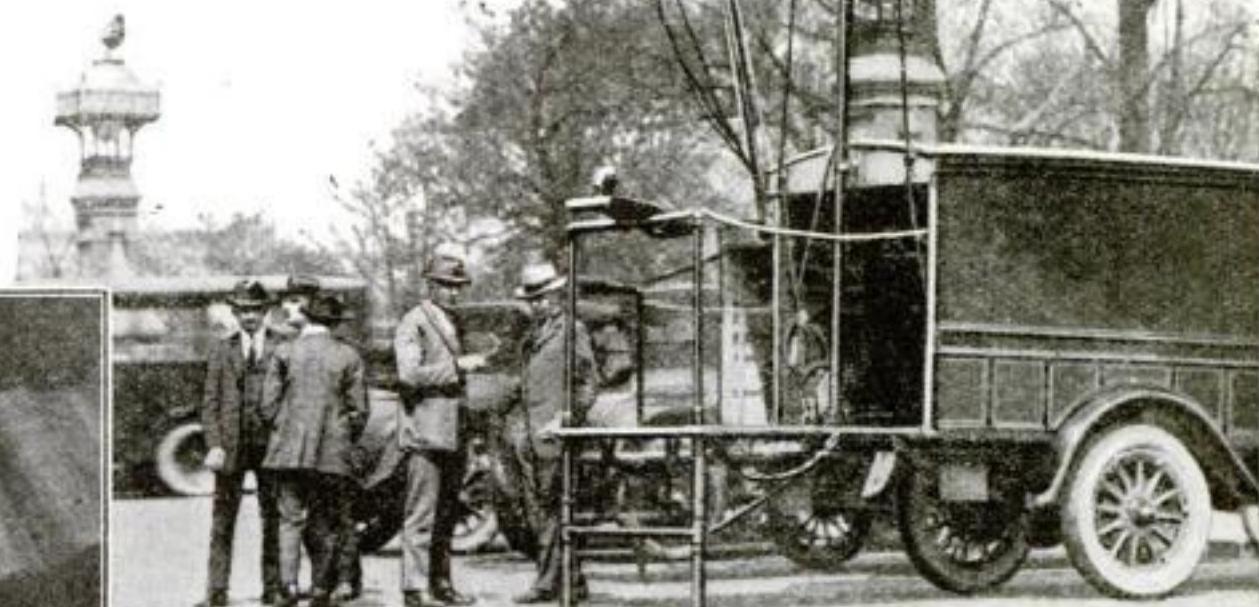
Mr. Harding from Marion in 1920, would be obliged to resort to the costly use of extensive land wire hook-ups. But the candidate making a tour, as did Mr. Cox, could have his speeches from each city broadcast by the local stations. Without a very great cost, he also could carry a broadcasting outfit in his special car, and thereby increase greatly the number of listeners to his train platform addresses.

A MAJORITY of radio stations probably do not know how much the spellbinder should be charged for the privilege of using their transmitters. Commercialization of broadcasting has not yet been accomplished generally. A few of the larger stations sell time in the air, charging about \$10 a minute when the broadcasting does not involve the use of trunk lines from one city to another. Many advertisers have found this a successful avenue of publicity. They do not attempt to advertise their wares directly over the radio, but endeavor to bring their names before the radio public through musicians, singers and other entertainers who are announced as performing "by courtesy of" the advertisers who employ them. Programs of this sort must be just as entertaining as other

audience. Acrobatics are lost to the microphone. The radio spellbinder needs a clear, concise message. He need not be an orator. In fact, many men who are not good public speakers have found themselves in demand as radio speakers.

Secretary of Commerce Herbert Hoover is an example. His carefully prepared addresses, read to an audience of banqueters, often is lost. Over the radio it is clear and logical. Secretary Hughes is another good radio speaker, though he is also considerable of an orator in public. Postmaster-

Radio on the stump—one of the motorized loudspeaker "platforms" that will help carry the voices of the presidential campaign to a radio audience that is estimated at 10,000,000 Americans



On several occasions recently the speeches of President Coolidge have been heard over the radio by unseen millions, notably his address at the Lincoln's Birthday dinner of the National Republican Club and his more recent speech before the Associated Press editors in New York City. In the latter case his entire message, and even the side remarks of those near him, the tinkling of ice in the glasses and the rattle of dishes, were heard by radio fans in every part of the United States

radio features, for the radio fan with a good set can tune out an uninteresting program, and tune in a more distant station whose offering meets his fancy.

This raises another question for the spellbinder. The oldtime orator who tore off his coat and collar and who made a windmill of his body as he spoke, will not be the speaker who holds a radio

General New and Secretary of Agriculture Wallace, both of whom have had considerable experience in broadcasting, find it a boon as a means of reaching people.

THE President, who finds it difficult to speak in public, has encountered some interesting experiences when speaking over the radio. He is the first President whose message to Congress was broadcast. On this occasion, the telephone company broadcast the address not only in Washington, but in Providence, Dallas, Kansas City, and New York.

While the President was speaking, the telephone company engineers received a telegraphic query from a fan in St. Louis, listening in on the Kansas City broadcast. He wanted to know what was the rustling noise he heard along with the President's speech.

The engineers traced the rustle to its lair. It was the President fingering the pages of his message, as he read it from the rostrum of the House of Representatives.

It takes a new technique in spellbinding to hold the radio audience. The person who is seated in a crowded hall at a political rally has no choice but to hear the speaker through, whether he likes it



or not. The radio listener-in, if he wearis of the speaker, can tune him out and tune in a jazz band from another station. It takes more than cold politics to hold him.

The speaker with a good string of funny stories has the advantage over the man with heavy logic. The man with a brief message, full of interesting facts, is listened to, where the windbag with an hour of flowery oratory talks to empty space, for radio puts the acid test on policies, issues, and men. Volume of voice, graceful gestures, or the all but hypnotic effect of a powerful personality will not make up for lack of logic, coherence, and a clean-cut, convincing message in a radio speech.

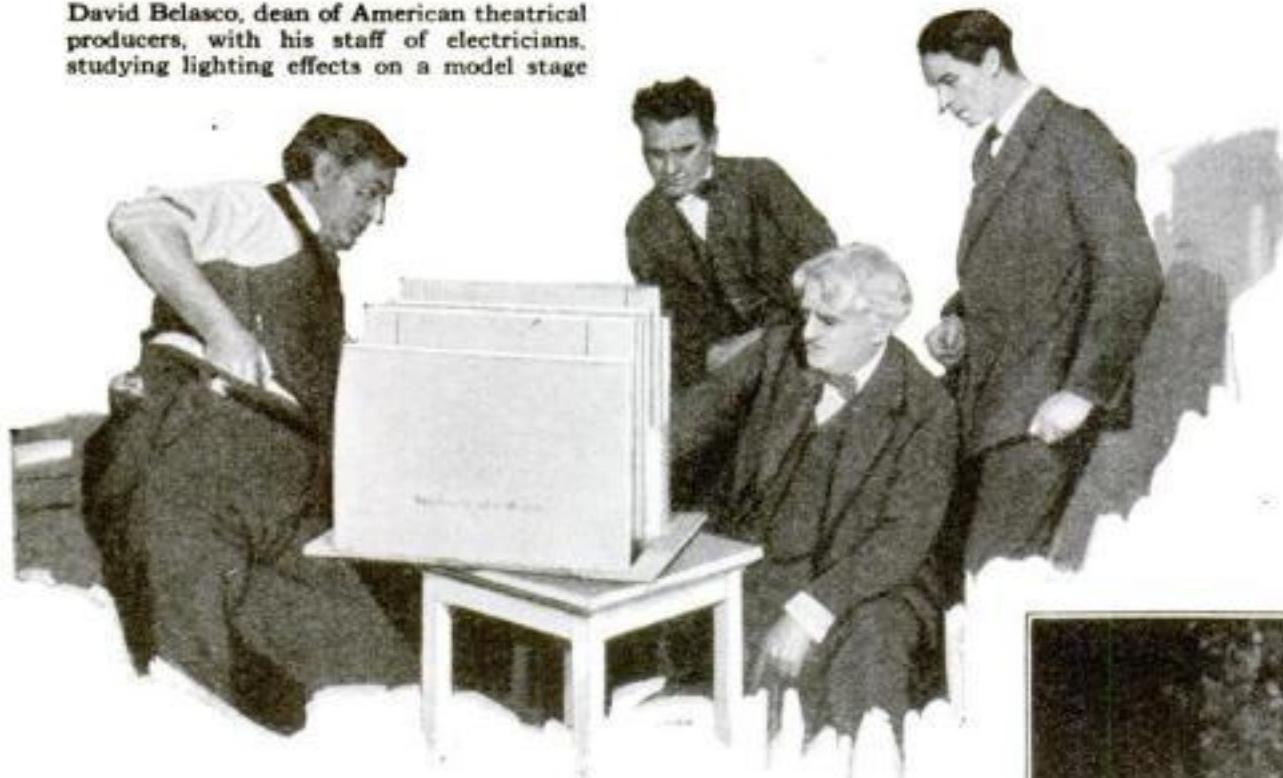
THE radio listener in the quiet of his own home has opportunity to ponder on and dissect the statements that come to him through the air. He can comment aloud if he cares to in entire security. He can silence the speaker permanently so far as he is concerned by merely turning a knob. More than ever before, public speakers must stand on their own feet, and succeed or fail by their own efforts. The applause and cheering of loyal party men, who have attended a meeting for the sole purpose of stimulating enthusiasm, will not help a speaker with his radio listeners, for demonstrations of hand-clapping and shouts become merely a confused rumble in a head set that the radio enthusiast finds distinctly annoying.

Former Senator Albert J. Beveridge,
(Continued on page 112)

How I Make Stage Sunlight

By David Belasco

David Belasco, dean of American theatrical producers, with his staff of electricians, studying lighting effects on a model stage



MEN who make a study of light say that what we call light really is vibrations in the ether hitting our eyes. Certain it is that the future holds much promise for the scientific researcher in the subject.

Sunlight, Mr. Belasco's aim, is called white light. But it is a combination of red, orange, yellow, green, blue, indigo, and violet. Paint these seven colors on a circular bit of cardboard, spin it rapidly, and it all will look white.

In the accompanying article the famous theatrical producer tells of his lifelong efforts to create a true semblance of sunshine for the stage.

SINCE my callboy days at the Baldwin Theatre in San Francisco I have been interested in lighting. The conviction that light is the greatest external influence upon mankind always has been in me. Since the stage mirrors life, it seemed to me that light was a great force in producing stage effects. While I believe "the play's the thing," light is an aid. It aids and abets the producer's best efforts.

I have done all in my power to forward the evolution of light as an aid to the theater. In my boyish days of barn-storming through California, I played by the light of smoking kerosene-fed lamps. This form of lighting still persists in some communities. Not so many years ago, David Warfield played "The Music Master" with kerosene lamps in a playhouse in Oil City.

In my eagerness to improve conditions, I once secured a dark lantern of the kind used by the gentleman burglar and his lowlier fellows. I manipulated it for concentration upon one spot in the scene that I desired to emphasize. I used light not merely to light the stage but to stress a scene.

Years afterward, I employed engine headlights, those great single eyes that

pierce the night and warn us of the locomotive's imminence. This furnished the strong light I desired on some scenes. But it, too, was unsatisfactory, because it was far removed from my model—sunlight.

"Nearer sunlight nearer perfection in stage lighting." That is the ideal toward which I have been striving all my life. It was in the production of "Mary, Mary, Quite Contrary," with Mrs. Fiske, that I attained it. Through 40 years of experiment I had received much praise for my imitation of nature's lighting, but it was only after the opening of that play that I heard the coveted words, "It is like a day out of doors!"

The reason why lighting on many stages gives distorted pictures of life is that the light is not balanced. The average manager who wants to light his stage well turns on all the lights available. He does not realize that mere profusion of light fails to give the impression of sunlight. It gives only the impression of a vast waste of artificial light.

From that flood of light his actors suffer. Strong light from above—emphasizing every slightest shadow—carves lines in their faces. It cuts gashes in skin that is satin smooth. It makes the actor look 20 years older. It is cruel. It is inartistic. It is unnatural. Strong lights from below have a different but equally appalling effect. They distort the features. Delicate, pale faces they convert into blur.

It was when I produced "Du Barry" that I first used the now well known Du Barry pink. For the scene in *Du Barry's* bedchamber I wanted a soft light that would beautify the room and its occupant. Mrs. Leslie Carter had



Mrs. Fiske in "Mary, Mary, Quite Contrary," the play in which Belasco finally achieved a true semblance of sunshine. Note how the soft white light, produced by diffusion of the fundamental colors, is reflected upon the figure of the famous actress

beautiful red hair. I wanted a light that would emphasize and yet soften its beauty. Bright pink lights would not accomplish that purpose. I tried tint after tint of pink. At last I found one that produced a mellow, genial light. That was the origin of "Du Barry pink."

My next important experiment was in modifying the useful but inartistic arc light. Circles of mica were placed about the lens, narrowing by degrees the field of light and enabling me to focus upon an object without an all-revealing glare. The circle that permitted the light from the mica-surrounded lens to pass through often was not more than an inch in diameter. This was used with gratifying effect in "The Rose of the Rancho."

As the curtain rose upon that play of Spanish life in America an old priest was

discovered asleep in an arbor. The narrow ray of light from this contrived circle was directed upon two grape leaves in the arbor. The light was reflected upon the face of the sleeping monk. At the gate of the monastery the light was directed in the same manner upon two leaves. The light from the leaves was reflected upon the grass.

IT IS for such touches that applause is heard in my theater when the curtain

ditorium. They were arranged in groups with amber shades in the ceiling. Along the floor the amber lights were repeated. The lights arranged along the wall had white silk shades. The side lights were brighter and harder, so that audiences might find their seats.

One of my most gratifying experiments was when I produced "The Return of Peter Grimm." It was necessary that Peter enter the room where his friends were talking about him, without their see-



Machine shop in the electricians' room of the Belasco Theatre, showing Mr. Belasco (third from the left) and his assistants at work in their experimental lighting laboratory

rises upon the first scene. My gracious audience recognizes that by some novel means a natural effect has been secured and thus gladden my heart by their approval.

For the production of "The Rose of the Rancho" I had six men working at the lights. I needed all of them to give the impression of outdoors in the garden life of California. It was pleasing, and friends and critics assured me it was a triumph. But I was not satisfied.

My next invention was the baby light. The arc light was ponderous, overwhelming. It refused to be tempered to the point of softness that I required. Therefore I worked out the plan for the baby light. It is a lens about one fourth as large as the arc. It is incandescent. Suspended from the gridiron and the galleries, baby lights can be regulated by dimmers to the gentlest glow.

I gave my attention for a long time to reflectors. How to arrange them to secure the right degree of glow was a problem. We worked and worked. I gave five days to a rehearsal of lights at Washington. It cost me a thousand dollars a day, but it was worth it.

SKILFUL manipulation of the lights by means of reflectors was a long step. But it did not take me to my goal. I had passed my brother managers in the race, but that had little significance. They did not care about lighting. I did.

When I opened the Belasco Theatre in New York, something occurred that disturbed my audiences and the critics. "We can't read the programs," they complained. "We can't see our friends in the audience."

"You will grow used to it," I answered. There were 4000 lights in the au-

ing him. It was necessary, too, to convey that he was dead. I did this by keeping the back part of the stage dim and by picking out *Peter Grimm* (Mr. Warfield) with a light. Every one of the players was followed about by a light.

But still I was not satisfied. I wanted something better. I found it when Mrs. Fiske appeared upon my stage last season. With "Mary, Mary, Quite Contrary," my dream of 40 years came true. I had secured a true semblance of sunshine.

This was done by diffusion of light. Upon a sheet of heavy glass, mottled paper was spread and fastened. Over this were placed sheets of silver leaf. The silver leaf was colored in the fundamental hues. The plate of glass, mottled paper and silver leaf was attached to the stand of a baby light. It threw a soft light instead of a glare. Light reflected from the invention had solved my problem.

THE light diffused upon the stage created the illusion of sunshine. To actually reproduce nature on the stage would have been crude, prosaic. We had approached as near to nature as the stage allows. To come as near to it as I have with my artificial sunshine is the thing. I have heard it is the

last word in stage lighting. Perhaps.

Light must come from the right lamp to produce the right illusion. I have lamps from every part of the world—2000 of them. Some of them are in my shop in the basement of my theater. But they have overrun the shop. Many of them have had to be sent to the storehouse. I have need of all of them. One day last week I found in an auction sale a beautiful old Italian lamp. I may produce an Italian play some day and that lamp will be an asset.

I WOULD not finish this contribution without a word to the home makers. Light is as great an aid in the home as in the theater. Issuing through colored shades it leads an army of beneficent sentiments. Many a girl has brought the bashful suitor to a proposal with the help of a delicately tinted pink lampshade. Whereas darkness breeds villainies.

You may cry "extravagance," but no worthy ideal is extravagant. Let us have plenty of light—the right light—in our homes.

We can adapt an idea according to our purses. The most used room in a house should have three kinds of lights. There should be lights from a chandelier—be sure to make pink shades for it—for general use. There should be a reading lamp to throw the glow upon the page instead of the eyes.

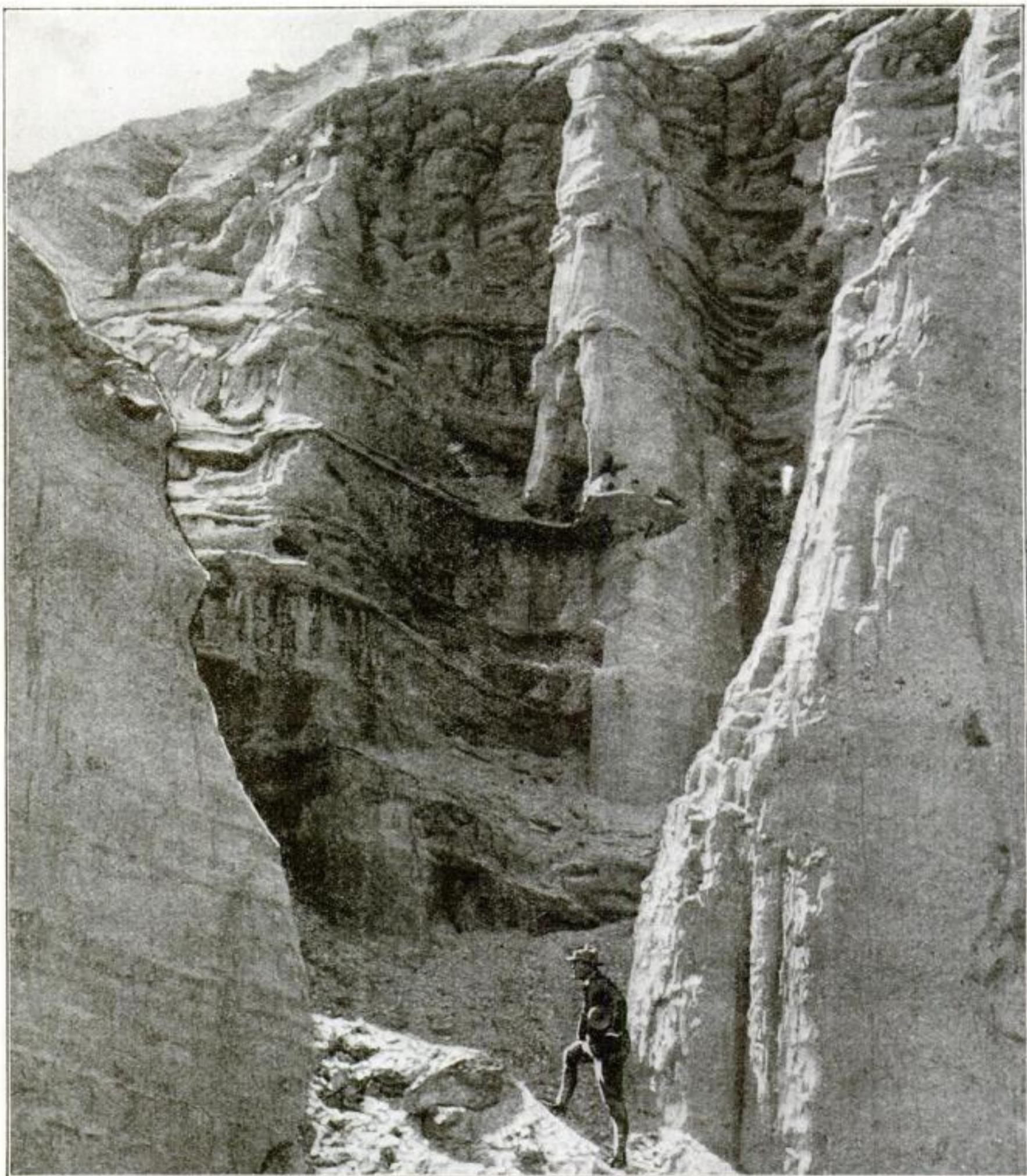
Eyes should not have to do battle with a strong light. They focus upon but one



The lamp room in the basement of the theater. Here Mr. Belasco has collected 2000 unusual lamps from all parts of the world. He says he has need of every one of them—for atmosphere or light

third of the page, the black print. There should be a lamp that will diffuse the light through the room. There are lamps that cast the light upon the ceiling, which light is reflected upon the floor. That is the light in which to live, the best light for art and for service.

An unusually practical article in next month's issue will describe in detail how to wire your home for radio.



Desert Cliffs Yield Ancient Secrets

OF AMERICA'S little-explored natural wonders that are being opened to tourists by the completion of new automobile highways, few are more interesting from a scientific standpoint than the majestic cliffs that mark the site of ancient lakes in the now waterless wastes of the Mojave Desert in southern California.

Here from the depths of deep defiles rise great buttressed walls fashioned through the ages by nature's architecture. These strange formations in the heart of desert lands hold for the scientific explorer a fascinating story of the ages, giving up new secrets of evolution on the American continent.

Millions of years ago, geologists tell us,

the present waterless country of the Mojave Desert was dotted with lakes and rivers. Into the lake waters year after year spring freshets and floods washed sand and clay, laying down layer after layer of mud in the lake bottoms.

Now, by some unrecorded convulsion of the earth, these lake bottoms have been lifted up, and the rains of the centuries gradually have cut through them, creating the buttress-like formations. The projecting, shelflike layers in this picture mark the harder strata, where the material deposited in the ancient lake bottom happened to be sandier and solider than usual. These harder strata have resisted the rains more than the rest.

In the softer clay between the harder

layers, modern geologists have found the bones of animals long extinct—animals that reveal important stages in evolution as it was enacted on the North American continent. The clay layers have yielded, for example, the bones of a remote ancestor of our modern horse.

SCIENTIFIC interest in these discoveries has been increased by the recent finding of five prehistoric human skeletons, standing upright in undisturbed strata at Los Angeles, only a comparatively few miles to the west. Scientists believe the skeletons date to the last Ice Age, 125,000 or more years ago. Further excavations will be undertaken in the hope of revealing relics of glacial days.



Courtesy Mount Wilson Observatory

One of the unfathomed mysteries of the heavens is the great dark nebula in the constellation of Orion—a black "hole in the sky" seen near the center of this magnificent photograph made with a powerful 100-inch reflector. It is called "the Horse's Head." Astronomers be-

lieve it actually is a colossal mass of non-luminous matter that blots out the light of bright stars beyond it—possibly a strangely shaped "dead universe," a heavenly derelict floating through space at distances so vast that our minds cannot begin to comprehend them.

The World's Greatest Spectacle

By Raymond J. Brown

NO DOUBT you have read about the work of uncovering the tomb of Tutankhamen. Probably you have been greatly impressed, for there is drama and thrill in the thought of men cutting their way into a place that had been seen by no eye and touched by no hand in more than 30 centuries.

Suppose, though, that some one were to stop you today and offer to take you back 70 or 80 centuries before the time of Tutankhamen; to let you see with your own eyes certain events of 10,000 or 11,000 years ago—not reproductions of those events, nor relics of them, but the actual events themselves? What do you think you would say?

You probably would think the suggestion absurd, and yet if the man who made it happened to be an astronomer with a telescope, he could fulfil every one of his promises. For if you care to see certain events that antedate the beginning of the Christian era by at least 8000 years, it is necessary for you merely to go out of doors any one of these clear summer nights and look at the sky through a telescope.

Here and there in the heavens the telescope would disclose cloudy patches of light, and

when you saw them you actually would be carried back at least 10,000 years. For those cloudy patches are star clusters, containing tens of thousands of stars, some undoubtedly larger and brighter than our sun, but so far away from the earth that their light, traveling 186,000 miles a second, requires 10,000 years to reach us! Which means that when you see that light, you actually see something that left those stars thousands of years before the

dawn of the oldest civilization that existed on earth! A perfect link between the present and the past!

Moreover, though some of these far-distant star clusters cannot be seen without the aid of powerful glasses, they are so large that it would take a beam of light 500 years at least to cross one. And only from those relatively close does the light reach us in so short a time as 10,000 years.

Astronomers estimate that the light from many of them does not reach us in less than 200,000 years, while only a few months ago there was discovered in the constellation Sagittarius a faint haze whose light is estimated to take 1,000,000 years in its journey to the earth! This is by far the most distant object ever viewed by man, and yet astronomers do not say that it marks the limits of the universe. They have formed an opinion regarding the extent of space, but that opinion is not based on actual measurements, for even the marvelous instruments of modern astronomy are incapable of measuring the distance from us of masses, which, while probably made up of as many as 100,000 suns, still cannot be seen except with the help of a powerful telescope!

To speak of the components of those distant patches in the skies

The Tremendous Mystery Story of the Sky

MR. BROWN'S story of the wonders of the heavens and their immensities gives us a new sense of the mystery and adventure of life. He tells us, for example, of the recent discovery of a faint luminous haze—another distinct universe of suns and planets like our own universe of the Milky Way, yet so far distant that to reach us its light, speeding 186,000 miles a second, must travel for a million years!

A universe five times as distant as the farthest star in the Milky Way, too far away for our eyes to see it or for our minds to comprehend it; too far away for our most powerful telescopes to catch more than its hazy, cloudlike luster! Such figures make us wonder if, after all, there is a limit to bigness and to smallness.

And yet by correct observations of these tremendous heavenly bodies your daily life is regulated. Your watch, your clock, the vessels on the seas, and the trains on the land—all depend on the astronomer's telescope.—THE EDITOR.

as "suns" is quite correct. All stars are suns, and the sun is a star. Also, our sun, which seems to us the undoubted ruler of the heavens, is only an average star. In an area of the Milky Way only as large as the full moon, telescopic photographs have shown 80,000 stars, as many of which are larger than the sun as are smaller.

MANY of the tiniest specks of light you see in the sky on a clear moonless night are stars that are immensely greater than the sun. In fact, if you pick out any faintly luminous star at random, the chances are that it is just as bright as the sun, just as large (about 855,000 miles in diameter) and of about the same mass, which is about two billion billion tons.

If you pick out a brighter star, it is altogether likely to be a greater sun than ours. It might even be Antares, which is 400 times larger than the sun, or Betelgeuse, more than 200 times larger, or Arcturus, about 25 times larger. There are between two billion and three billion stars from which you may choose, according to the estimates of astronomers, although only a few of these can be seen without a telescope. When you look up at the sky on a clear night, the number of stars you see may impress you as running into the millions, yet actually not more than two to three thousand are visible to the unaided eye from any one place on earth. If you could make observations from several parts of the earth you might count between six and seven thousand. Seventy-five per cent of these are giant stars, such as Antares, Betelgeuse and Aldebaran.

NOW, many of the two to three billion suns that we call stars are believed to be like our sun in at least one other important respect. Around them satellites are whirling just as around our sun revolve the earth and the seven other planets. In other words, what people on the earth are accustomed to regard as the world, or the universe—the sun and its planets with its star-studded canopy of sky—actually is only an infinitesimal speck in the real universe. It is only one of several thousand—possibly several hundred thousand or several million—other worlds that lie in the depths of space.

To attempt to measure the size of the real universe in miles would be futile and merely confusing. To most of us distances greater than 25,000 miles, the approximate circumference of our relatively tiny earth, are incomprehensible. Thus, even to speak of the sun being 93,000,000 miles away from the earth—a short distance by the standards of stellar space—conveys no clear impression. What are we to say, then, of the star clusters whose dis-

tance from us is 1200 million billion miles? To give an intelligible idea of distances like this, astronomers have selected the light-year as their unit of stellar measurement. This is the distance that light will travel in a year—approximately six trillion (6,000,000,000,000) miles. In the

Write that number down—a "1" and 15 ciphers—then try to compute how long it would take the *Shenandoah*, with her cruising speed increased to 100 miles an hour, to fly there from the earth! Then remember that these stars are our next-door neighbors, and that only a few of them are so near us. In fact, only about 30 lie within 100 trillion miles, or about 17 light-years from the earth. And only a thousand or so of the remainder are at distances from the earth that can be computed within hundreds of billions of miles. The rest—and remember there are between two and three billion at least—may be anywhere from 50 to a million light-years away. Science doesn't know, nor can the most delicate instruments and ingenious methods yet devised fathom, the true distances of space.



Courtesy Mount Wilson Observatory

Trifid nebula in the constellation of Sagittarius, apparently a cloudy patch of white-hot gases almost invisible to the unaided eye

case of those far-away star clusters, astronomers would say that they are 200,000 light-years from the earth, which means that it takes light 200,000 years to pass from them to the earth. When we remember that light from the sun reaches us in a little more than eight minutes, we begin to perceive what stellar distances actually mean.

For example, Alpha Centauri, one of the closest stars to us, is 25 trillion miles, or more than four light-years away. Sirius, one of the brightest stars that we see, is more than twice this distance from the earth. The mighty Betelgeuse, which, for all its vast size of 200 times that of the sun, seems just a red button on the shoulder blade of Orion, is more than a million billion miles away from us.



Courtesy Mount Wilson Observatory

The star cluster of Hercules that to any but powerful telescopes appears as a hazy patch. In reality it is a group of countless suns many millions of miles apart, and so far away from us that their light would be visible thousands of years after they had become extinct. Each pinpoint of light in the photograph is a sun. Many of them are far larger than our own, and probably, like ours, are the centers of solar systems of planets and moons.

Now, the nebula in Andromeda is 100 million times as large as our sun. Its diameter is a million times greater than the distance between the sun and the

earth. If you could place a radio transmitter on one edge of it and a receiver on the other, a signal sent out by the one would not be received by the other for almost 20,000 years. And yet, were an astronomer to give you the exact location of this huge cloud of fire, you probably would strain your eyes vainly to see it unless you had a telescope. For this tremendous area of luminous gas is comparable with the entire expanse of the heavens as a single drop of water is with the torrent of a Niagara. And that is not because it lies at the outer boundaries of space. On the contrary, by the reckoning of astronomers, it is only in the middle distance.

THIS nebula is moving slowly toward the earth—slowly, that is, according to the speed at which celestial bodies move. It is approaching us at something around 200 miles a second—about 60 billion miles a year. Some day it may reach us, but that fact need occasion us no alarm. For the nebula is so far away that, even moving at a rate of 60 billion miles a year, it would not approach perceptibly closer to us in a billion years! And remember that this fiery cloud is reasonably close to us if we compute its distance by the tremendous standards of the skies!

Sometimes we have visitors from the heavens. You have seen them in museums. Possibly one has reached the earth close enough to your home for you to have seen it before a museum claimed it. These visitors look like huge rocks, although they often are solid metal, and are called "meteorites." They are bits of cosmic flotsam, varying in weight between an ounce and more than a ton. Astronomers say that

When you see these huge masses of rock burst into flame in the air, you say you have seen a "shooting star." The little streak of fire seems to be far out in space among the stations of the heavenly bodies whose distance from us is measured in light-years. Actually, though, it is only between 20 and 80 miles away. At the greater distance the meteorite, which is traveling about 25 miles a second, begins to glow. It rapidly reaches full flame; at 20 miles it is entirely consumed.

Sometimes countless millions of these meteorites make up a little army of their own and start marching through the heavens. When such a swarm travels close enough to the sun to be influenced by its gravitational

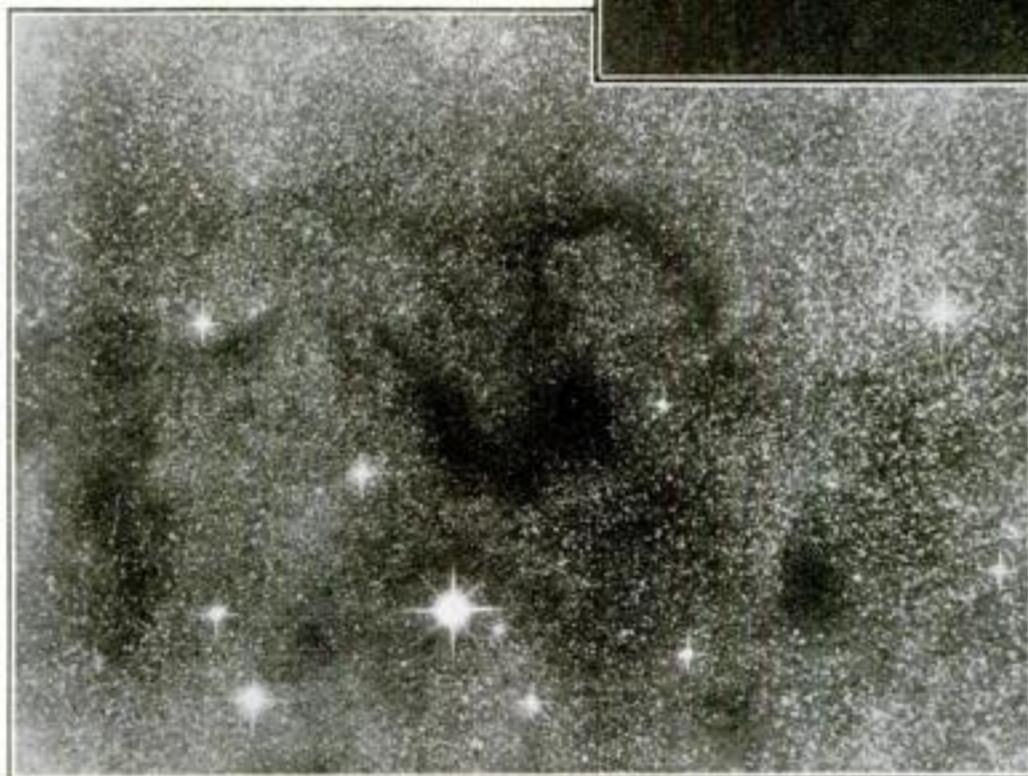
tails of comets without harm. Comets come and go. They pass out of our field of vision eventually only to be led back into it again by the sun's gravity and to become visible to us once more.

Just as the "shooting stars" appear to be far out in space, all the heavenly bodies, with the possible exception of the moon, seem the same distance away. The sun and the moon appear to be larger than the stars, some stars appear fainter than



Courtesy Mt. Wilson Observatory

The spiral nebula, Canes Venatici, photographed with a 60-inch reflector. Astronomers tell us that the galaxy of the Milky Way, of which our own little solar system is a comparatively insignificant part, may itself be a spiral nebula much like this—a whirling discus of stars, so huge that it takes from 25,000 to 50,000 years for light to travel from one side to the other! Our sun is comparable with one of the tiny specks of light on the outer edge of the circular mass



Courtesy Mt. Wilson Observatory

In the center of this photograph is seen the mysterious S-shaped dark nebula of Ophiuchus, surrounded by countless jewel-like suns



© Keystone

The Morehouse comet, as photographed at the Yerkes Observatory in 1908. It is made up of countless millions of meteorites whirling around the sun in a swarm, sweeping a huge "tail" of vaporous matter. The tail, many millions of miles in length, was not visible to the naked eye. Note how the far distant stars shine through the diffused cloud-like substance of the tail

from ten to a hundred million of them are hurled at the earth every day. Few, though, reach the earth's surface. The rest are burned in the heat generated by the resistance of the earth's atmosphere to their terrific speed.

force, it begins to whirl around the sun—as the earth does—and becomes a comet. From the rear of this army, and in a direction away from the sun, sweeps a huge "tail" of vaporous matter. Many times the earth has passed through the

others, but, unless you knew otherwise, it is scarcely likely that you would attribute these differences in size and luminosity to their real cause—the widely varying distances of the heavenly objects. This is scarcely remarkable since it is true also when you view far-distant objects on earth.

Now, even to the instruments of astronomy, the far-distant objects in the heavens—star clusters, for example, that may be from 50,000 to 200,000 light-years away—seem to vary in size and luminosity, but the fact that their distances vary widely is not readily apparent. That is why astronomers can offer only estimates of the approximate distance from us of the stellar bodies that lie close to the apparent limits of space.

AFTER observing thousands upon thousands of stars, however, astronomers have learned to interpret differences in luminosity in terms of differences in distance; hence, they are able to make quite accurate estimates of the distances of the most remote heavenly bodies by comparing the amount of light they give off with the amount of light that issues from stars of known distance.

In other respects, too, they have assumed the stars about which definite information has been obtained are typical

(Continued on page 113)

"Flying Autos in 20 Years"

An Expert's Visionary Picture of Motor Travel in the Future

WITHIN the next two decades autos will be made with folding wings, so that when on a straight stretch of road they can be spread and the machine will take to the air. The present-day tendency to lighten the construction of automobiles through the extensive use of aluminum alloys, without sacrificing the safety factor, and the great progress made in airplane construction as the result of recent experiments with motorless gliders, as well as motor gliders, are the two factors that will make this possible.

This combination automobile - airplane will have a body shaped similar to the present hydroplane hull, making it both a water and land machine. The wheels will protrude sufficiently to permit the machine to be driven on the highway after the wings have been collapsed, propeller disengaged and the automobile control mechanism applied, which in reality will give a three-in-one conveyance.

IMAGINE the convenience of being able to drive around in the city, as is done nowadays, and then when you start for some other town and get on a straight of way or enter a near-by pasture, to unfold the wings on the machine and take to the air! It will mean quicker transportation for the suburbanite, for people living at a distance from a large city, and for the traveling salesman who now uses the motor car and highways to cover his territory.

Recent glider trials held throughout Europe have shown ways of increasing the lifting power, while reducing the spread of airplane wings. Further, it has been demonstrated that with properly constructed wings and properly designed motors it is possible to fly almost any type of fuselage.

The development of automatic safety devices to control flight will decrease the liability of accident. Today, flying is no more dangerous than motoring on the

By E. V. Rickenbacker

Ace of Aces in the World War

streets and highways—sometimes I think not as dangerous. However, people have a fear of flying that will have to be overcome just as they had to overcome their fear of traveling 20 miles an hour in the horseless carriage of 20 years ago.

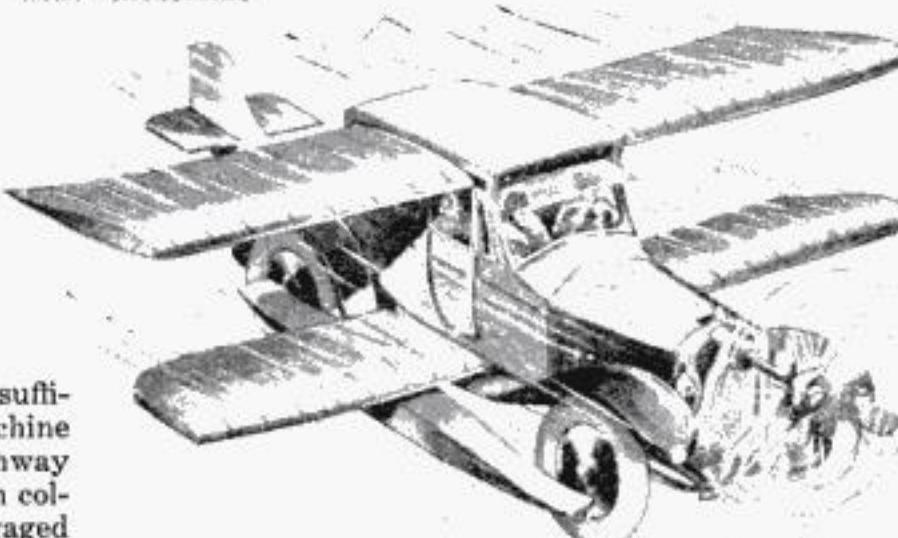
Save in time of war, there is no need for

horsepower as is used today through the use of a supercharger.

The wings will fold back against the sides of the car when driving along the street and will have sufficient span to lift the car off the ground at a moderate "take-off" speed. The 25-foot span that it is possible to build on the present-day motor-car— $12\frac{1}{2}$ -foot wings on each side—will be sufficient to lift the lighter and more efficiently built machine of 1940.

CONSIDER what such a machine will mean to the man who works in the city. He could live several miles farther away from the heart of the city and spend less time getting to and from work. By flying, more speed could be made with a greater degree of safety than now is possible on the streets and highways.

It would not take a great stretch of imagination to foresee municipalities regulating the height of buildings to uniformity, the streets to be bridged, in order to form one vast landing-field in the center of each city for flying machines. The landing-field or tops of the buildings could be connected with the street level by elevators so that a machine alighting could descend to the street and be driven about as an automobile. At the end of the business day it would be driven



Our artist's conception of the automobile-hydroplane of the future as predicted by Capt. E. V. Rickenbacker. The machine would be equipped with folding wings for flight and with pontoons for water travel

stunt flying, and that is the only really dangerous part in flying. It is a good bit like driving through heavy traffic at 60 miles an hour—every one doesn't have the skill to do it.

Rigid rules will be laid down for flying, much the same as there are rules for vehicular traffic today.

In the combined automobile-airplane I see a machine that is not greatly different from the present-day motor car, except in its decreased size. The body will be narrower and shorter, to reduce weight, and will be of a modified streamline design. The engine will be made lighter and smaller, but with about the same



How the flying roadster may appear if Captain Rickenbacker's predictions are fulfilled—a model built by Allen H. Russell of Nutley, N. J.

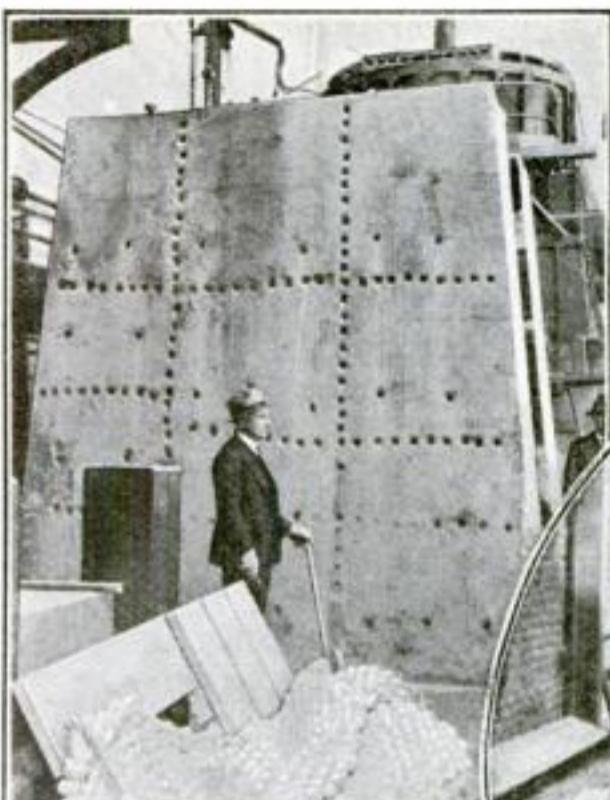


Rickenbacker as an automobile speed king

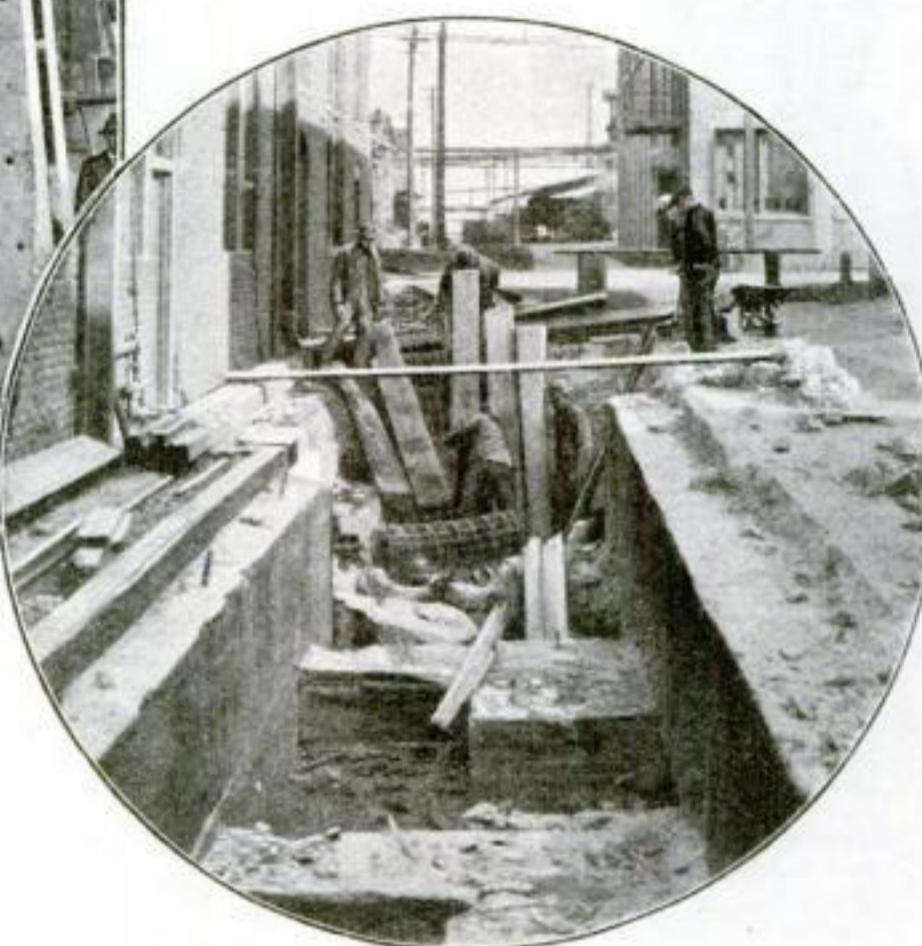
back to the elevator and lifted to the roof to take off for the homeward flight.

Such a forecast is more than pure fancy. It is founded on present progress in automobile and airplane design.

NEXT month: A dramatic story of a young immigrant who, by his own mechanical efforts, found a way to travel on land faster than any other human being. His life story is a thrilling romance of mechanics. You can't afford to miss this unusual personal story of the swift progress of applied science.



Above: Preparing to blast away a 90-ton reinforced-concrete foundation at the Lehigh Valley Light and Power Company, Allentown, Pa. Dynamite charges placed in holes drilled in the face of the pier cut it neatly into blocks without disturbing near-by machinery. At the right: Dynamiting a concrete pit at the Philadelphia Dupont Paint Works—a view after the first shot. Not a window-pane in the building at the left was broken.



By H. E. Davis

MOVED mountains, turning rivers from their courses, or leveling huge barriers of rock by the use of dynamite are tremendous feats, yet they are performed so frequently in engineering projects that they no longer occasion surprise. Recently, however, dynamite has been put to a variety of new uses, which, though less spectacular, are even more remarkable than the giant blasting operations usually accomplished by means of this powerful explosive.

Dynamite now is being used in small quantities as a substitute for the pickax, the sledge, the crowbar, or the cold chisel and hammer in such unusual places as large factories, or even the holds of ships. Moreover, it is being fired in the midst of valuable machinery, electric switchboards, and similar equipment without stopping the machinery or even breaking a window-pane!

Recently, for example, the Lehigh Valley Light and Power Company of Allentown, Pa., wished to remove the reinforced-concrete foundations of three turbine generators. Each foundation was 12 feet square and weighed 90 tons. Near by was machinery that could not be shut down without cutting off the electric current from several towns and trolley lines. A 22-inch steam pipe carrying 250 pounds pressure to the inch ran within a foot of the foundations.

Drilling holes with jumpers and sledge hammers and breaking the concrete off bit by bit with wedges would have required 10 weeks.

The company decided to try dynamite. Holes four feet deep and 15 inches apart were drilled in the face of the pier and loaded. Each charge consisted of a three-inch section of a one inch by eight inch

dynamite cartridge primed with an electric blasting cap.

On top of the charge tissue paper was tamped in lightly to afford a two-inch air space, and then wet clay was tamped tightly to the mouth of the hole. A blasting mat was placed over the foundation, and when the shot was fired, it simply cracked the concrete without throwing any fragments.

By successive shots the pier was cut into blocks as neatly as if with a chisel. The operation of the plant was not interrupted, nor was any damage done.

EVEN a more remarkable instance of the new use of dynamite took place in an electric-lighting plant in Denver, Colo., where gelatin dynamite was employed to remove a solid cast-iron pulley wheel weighing more than a ton from a shaft to which it was rusted fast.

Charges of the explosive, skilfully fired in holes drilled in various parts of the wheel, shot away the spokes, split the rim, and finally cracked the hub into two pieces that dropped to the floor, leaving the shaft entirely unharmed.

The total amount of explosives used in breaking up the wheel was 30 sticks of

dynamite, 50 caps, and 40 feet of fuse, making the whole cost of materials less than four dollars.

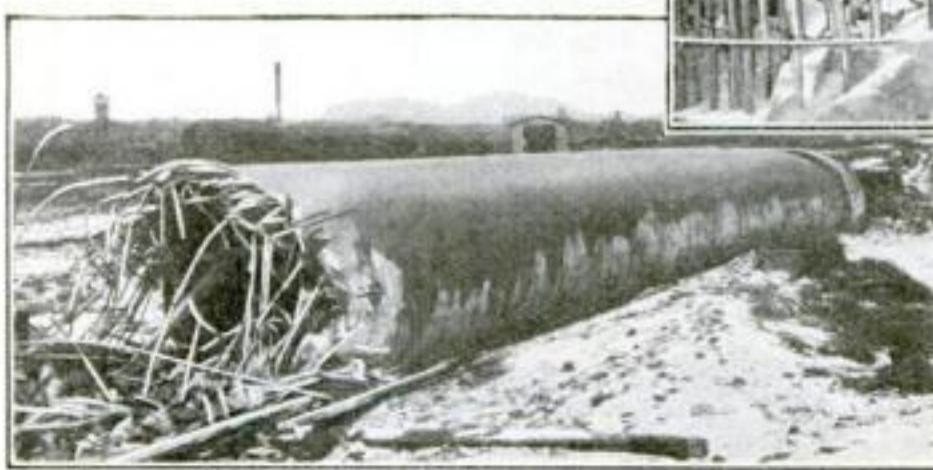
AT SPOKANE, Wash., a steel reinforced-concrete smokestack, 10 feet in diameter at the base and 210 feet high, located on a deserted crematory site, caused the city engineers much anxiety until they decided to bring it down with explosives. Sixty-five holes were drilled around two-thirds of the circumference, in a belt about four feet wide and a few holes in the remaining third, leaving about four feet intact.

The 65 holes were loaded and fired in groups to blast out the concrete. The steel reinforcing bars then were cut with an acetylene torch. A cable attached to the stack 100 feet above ground was tightened after each shot and after cutting the steel, caus-

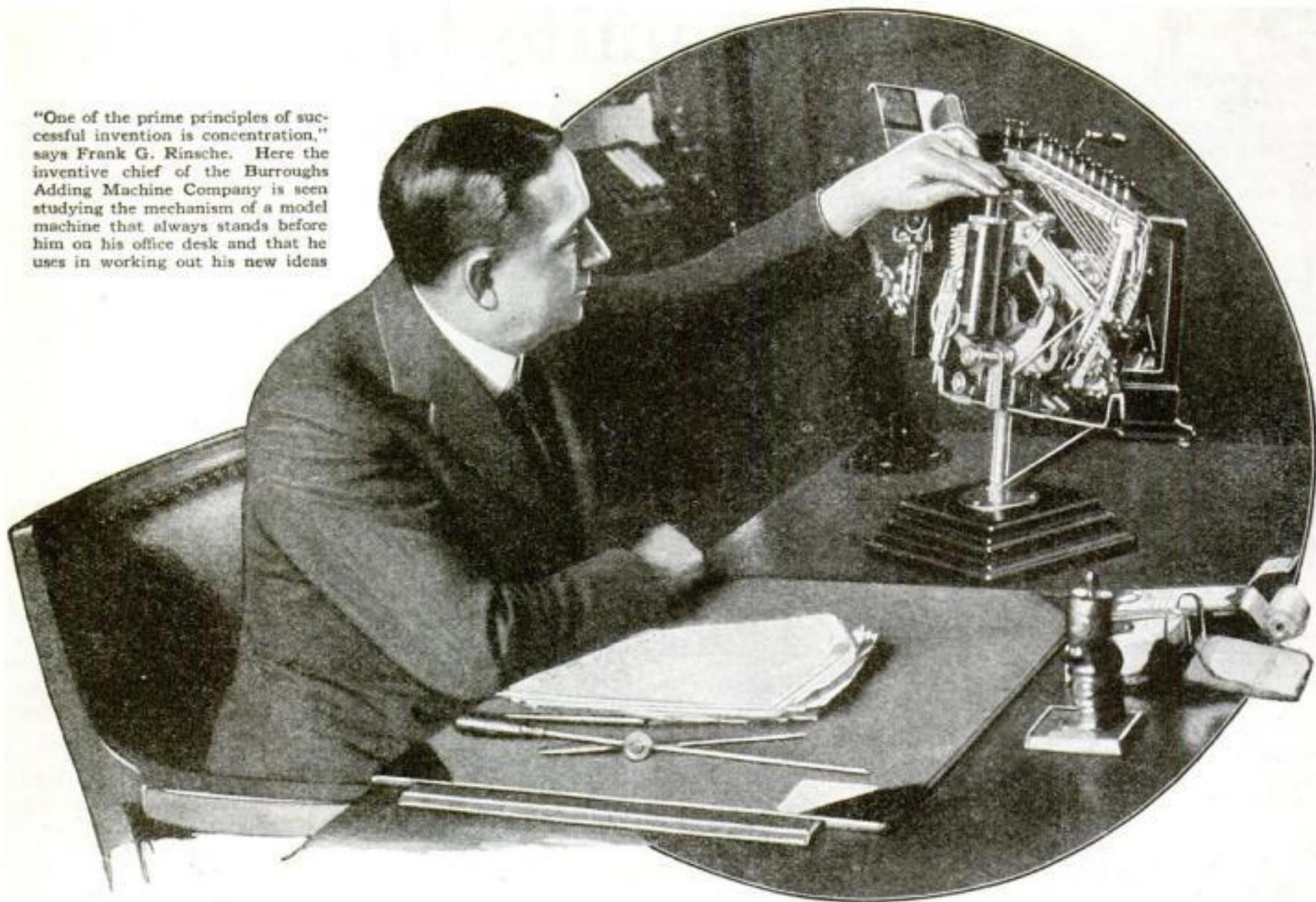
ing the stack to be pulled about $2\frac{1}{2}$ feet out of line. The holes in the remaining circumference then were loaded and fired, and the stack, breaking the reinforcing rods, fell in the desired place.

BLASTING in the hold of a ship may sound like a rash proceeding, but the Charleston Shipping Company of Charleston, S. C., will testify that dynamite recently saved them three days' time and 50 per cent of labor in unloading a cargo of potash that had become caked in the hold so hard that breaking it up with picks was extremely slow work.

Thus, in our ports in the midst of shipping, in busy city streets, and in industrial plants running at full speed, small charges of high explosive can be directed with the greatest nicety.



How a 210-foot reinforced-concrete smokestack at Spokane, Wash., was felled by dynamite. Above: Cutting the steel reinforcing bars after the concrete base had been blasted. At the left: The fallen smokestack.



What to Do with a Good Idea

By Frank G. Rinsche

HERE is something of the inventor in every man. You yourself probably have a good idea or two in the back of your head that you might work out some day. No doubt your ideas are excellent, but they always will remain ideas only unless you find what to do with them to turn them into actual accomplishments.

Back in the early eighties there was a man who thought the grinding task of bookkeepers, adding and subtracting endless columns of figures year in and year out, was a waste of effort. He thought these thousands of workers could expend their energies in a more useful direction or could do a greater amount of the same work much more accurately if they had a machine to help them.

When he told others of his idea, they laughed at him. How could a brainless machine of steel do calculating like the human mind? How could steel figures be made to think? It was absurd.

Nevertheless, that man, William Seward Burroughs, stuck to his conviction that such a machine could be invented. He had the purpose, the foresight, and the inventive genius to toil ceaselessly at his self-appointed task, with the result that from his idea he ultimately developed what has been one of the greatest boons to business ever evolved—the adding machine. This would still be nothing

more than an inventor's dream but for one thing: Mr. Burroughs knew *what to do with his idea!*

Mere ideas come readily enough. They are, perhaps, the easiest thing in the world to possess. Roger Bacon conceived the *idea* of a flying machine back in the thirteenth century, but he didn't carry out his idea to completion. So he wasn't the *inventor* of the flying machine. Getting ideas seems to be the easiest part of the inventor's job. His big work is to sort out the most practical of these ideas and give them practical expression. No man has a monopoly of ideas, no matter how specialized his field may be.

LYING on my desk is a copy of the Patent Office Gazette, a government publication in which are listed all the patents granted last week. According to this list the priority of 763 inventions has been recognized officially. This is an average week's production of the inventive mind of America. Taken in the aggregate it is the fruit of hundreds of years of mental and physical labor. Yet I believe that not more than five per cent of these 763 inventions have any commercial value.

Official records probably would support this belief. These inventions represent ideas that are clever and even brilliant; mechanical and engineering talents that are priceless; yet, with lamentably few

exceptions, they are not inventions that American economic life demands nor for which it will pay its richest rewards. In other words, they are not practical.

IN A figurative sense, the young inventor is too apt to search the world over for the golden opportunity actually hidden under some prosaic mask at his own doorstep. Some of the world's most useful inventions have been the result of overwhelming economic demands. Such an invention need not be an adding machine, a typewriter, a telephone, or other complicated apparatus.

The fountain pen, rubber-tipped pencil, alarm clock, and safety razor are but a few items of a list that the reader can select at random that met great popular response and made fortunes for their inventors. Behind each one there was an industrial, commercial, or social want that had to be satisfied.

However, the mere finding of a need for an invention is not enough to assure success and wealth. Others may have had the idea before. It is folly for an inventor to undertake a definite work until he has first ascertained from proper authority—the government Patent Office—what patents have been issued in his line. He can get this information at nominal expense and save perhaps years of useless toil.

One of the prime principles of invention

is concentration. The successful American inventor must be its faithful disciple. Through him the necessity of improving methods of handling office and shop operations will be satisfied in order to keep step with the growth of business. Manufacturer, business man, and banker are always on the lookout for any method or machine that will decrease overhead and production costs in office and factory.

IN AMERICA we distribute rewards on results alone, whether an invention was developed in a month, or a week or several years. Mr. Burroughs spent the best part of his life gaining the rewards that were ultimately his and that will come to every man who will have the perseverance to stay with a conviction that is practical until he sees its fulfillment.

Inventions are not accidents, nor are ideas inventions. Many practical men have ideas, but if these ideas cannot be evolved into serviceable inventions, they might as well be left unborn. The inventor of today must have a thorough training and practical experience to make a success of his calling.

In our case many good suggestions come from the users of our machines, but the good suggestions are greatly outnumbered by the impractical ones. For instance, one of the most frequent suggestions offered us was a pedal for replacing the hand-operated bar. A little thought would disclose the obvious fact that the raising and lowering of a pedal would be far more tiresome than the pulling of the little bar by hand.

ONE time a man wrote us he had an invention that would increase the output of our machine 100 per cent by placing one adding machine behind another with a single power unit operating both, so that the second machine would duplicate all computations made by the first. He never stopped to consider that the identical result could be obtained much more easily merely by inserting carbon paper between two sheets of white paper on the first machine.

Invention might be defined broadly as the science of satisfying human needs. Usefulness is the only reason for invention and the new method must be simpler than the old or the invention is quickly nullified.

The adding machine will serve as a good example. For almost 40 years every one connected with our inventions department has been concentrating on the development of new machines and features to simplify and improve old ones or to satisfy unfulfilled needs.

A particular instance of simplifying operations is found in one of the most substantial additions we have made, that of the electric motor. By saving the time and strength that an operator must expend in pulling a handle, we have increased his productivity greatly and have made him happier and more contented on

the job. The pulling of the handle seemed trivial enough, yet when you multiply that pull several thousand times a day, the task becomes one that would tax the strength of a professional strong man by the same principle that "constant dripping finally will wear away the greatest stone."

An amusing instance comes to mind in connection with this improvement. In one of our offices we had one of the first hand duplicating machines ever built. The office boy had the time of his life running it. But as soon as the novelty wore off he began to complain about the monotony of turning the handle. Finally

joy in exploring a piece of machinery about which it knows nothing. In addition, we had to take into consideration the fact that a careless operator might forget to turn off the electric power at night.

Concentration finally guided us through these and other problems with which we spent several long and hard years. Seldom did we spend less than from 12 to 16 hours a day on the work. When it neared completion, 24-hour days were common to all of us. But in the end we attained not only the addition of electric power, but also an ingenious automatic cutoff that took into consideration the careless clerk and automatically stopped the motor at the end of two or three minutes after the last operation of the machine.

An Inventor Who Has Put His Ideas to Work

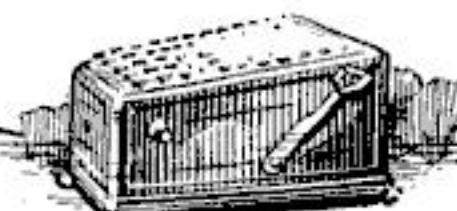
WHEN Frank G. Rinsche writes in the accompanying article that "usefulness is the only reason for invention," he is speaking from a lifetime of practical experience in inventive work—a lifetime devoted to the perfection and improvement of machines that have saved incalculable time and labor for the merchant, the manufacturer, and the office man.

For 14 years Mr. Rinsche has been active in the inventions division of the Burroughs Adding Machine Company, creating different types of figuring machines, and improving their usefulness by scores of new devices. He has been identified with the Burroughs invention almost since its inception.

Born in St. Louis in 1869, Mr. Rinsche attended public and private schools, then entered the Spanglerberger School of Engineering in St. Louis. To help pay his way he worked half days and three evenings a week in a machine shop.

In 1888 he went to work for Joseph Boyer, then owner of the Boyer Machine Shop. It was in that shop that William Seward Burroughs developed his first adding machine. Mr. Boyer later became president of the Burroughs Adding Machine Company.

Mr. Rinsche stayed with Mr. Boyer until 1895, when he went to England for the American Arithmometer Company, later the Burroughs Adding Machine Company. He has been connected with the inventions division of the company since 1910.



the lad got a brilliant idea. He came running out to the shop with it.

"Say, Mr. Rinsche," he called, his face fairly beaming with joy, "running that machine is darned hard work. Why don't you hook up one of those electric motors to it so that it will run easier? I'll bet I could turn out twice as much work then."

PARAPHRASING the old familiar story, we did, it did, he did. In fact, the boy ran off four times as many letters as he formerly did and he got more fun out of his job than he would have out of a baseball game. However, there were many obstacles between the conception and completion of this idea. For example, we had to allow for the fact that few business men, bankers, or clerks who would use our machines were familiar with the operation of an electric motor. We had to make it foolproof, for human nature is fascinated by the unknown. The spark of inventive genius that is in all of us to some extent finds its greatest

THIS is an example of getting hold of a good idea and giving it practical expression. Among a score or two of contributions that I have made personally to the improvement and refinement of the Burroughs machines, I feel that the most worth while was this application of the electric motor.

Within the next 10 years I look for even greater improvements in the handling of office work than there has been in the last 10 years. Every conceivable operation in the handling of figure work will be done by machinery. The business man of 1934 no more will think of returning to his office or store at night to spend long hours at the figure work of the day's business than he will think of taking his family out for a ride in a wheelbarrow. The readers of this magazine very likely will play a large part in bringing about the day when there will be no such thing as an office where mental calculations of any sort are tolerated.

In conclusion, and at the risk of being thought a reactionary, I want to state another cardinal principle of the science of invention, and that is fidelity to one's purpose. I do not believe many of the younger inventors of today appreciate the vital necessity of concentrated and unremitting toil that is necessary before specific objects are gained.

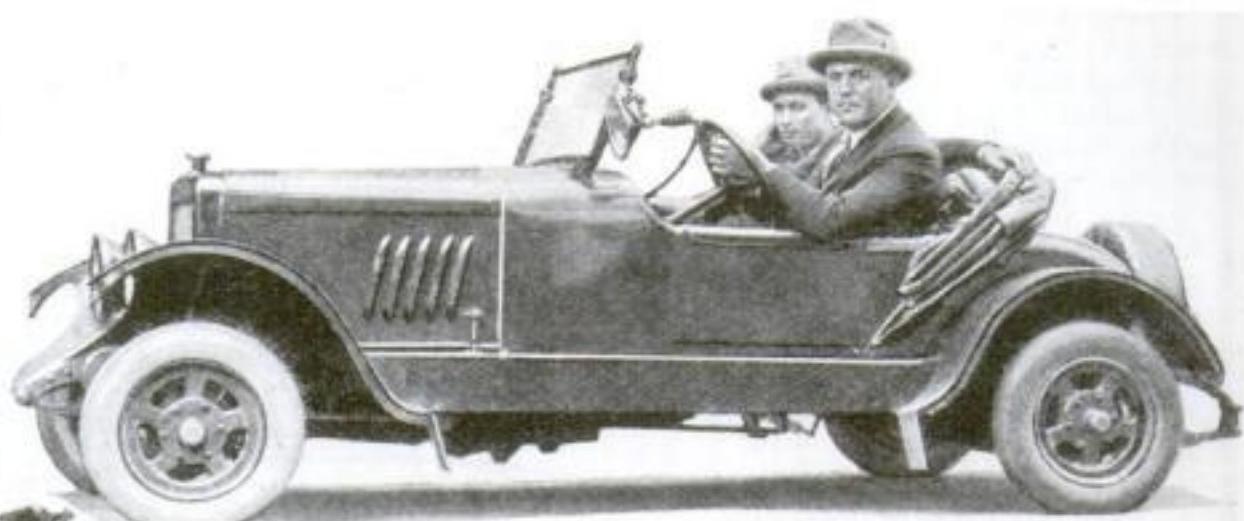
THE inventive road is a rocky one, but if a man like Edison, enjoying as he does the acclaim and rich rewards the world has given him for his many contributions to human progress and comfort, can devote from 12 to 16 hours a day to gain still greater goals, it is not too much to expect of young inventors, potential Edisons, that they forget time clocks and outside activities when a worthy inventive project is undertaken.

The Goddess of Invention is a jealous one. She demands being wooed with whole-hearted and unremitting fervor, but once her favor is won, her rewards often are the greatest that man can attain. They are rewards won for knowing what to do with a good idea.

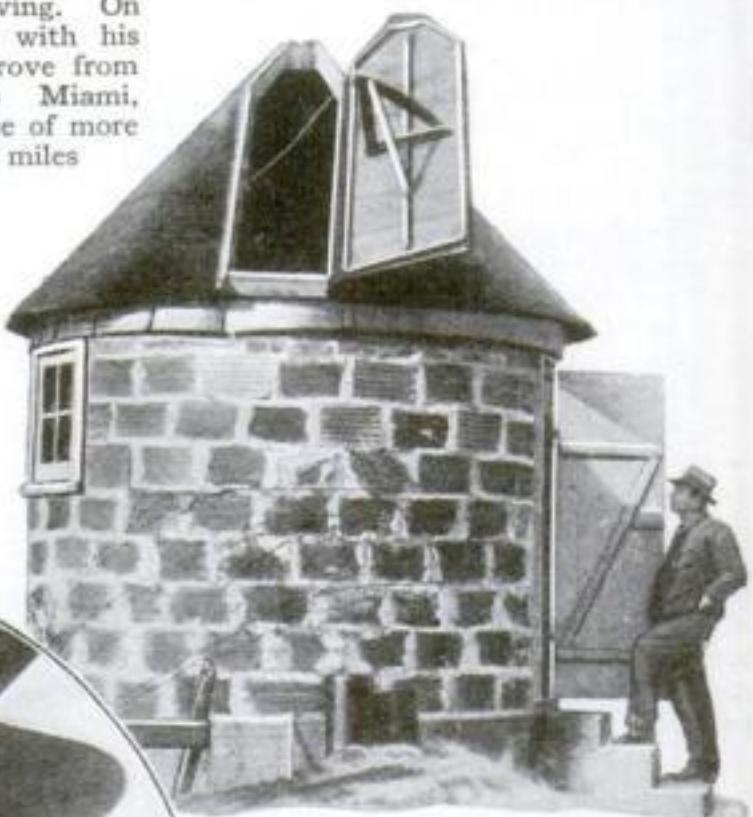
Oddities of Home Workmanship



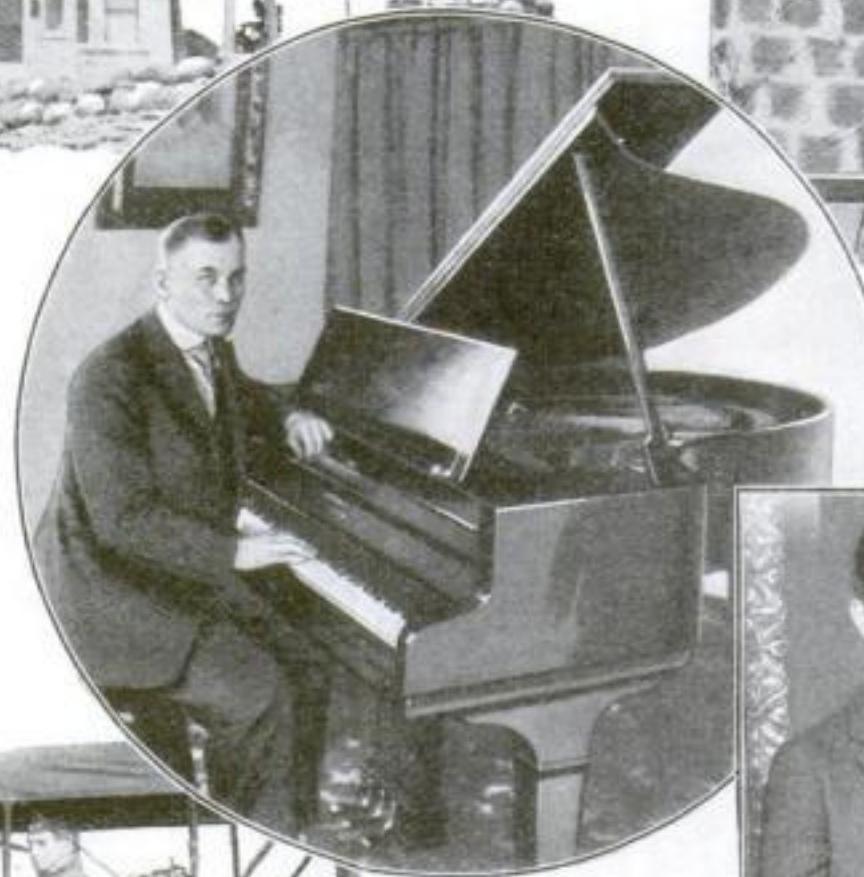
This odd tree dwelling represents seven months' work by Amos Espy, 82-year-old Civil War veteran of Westgate, Calif. It has two attractive rooms fitted with every modern convenience. The first floor is 30 feet from the ground



From old parts salvaged from a junk pile, J. H. Batchelor of Savannah, Ga., built the snappy sport roadster in which he is seen driving. On his first trip with his creation he drove from Savannah to Miami, Fla., a distance of more than 500 miles



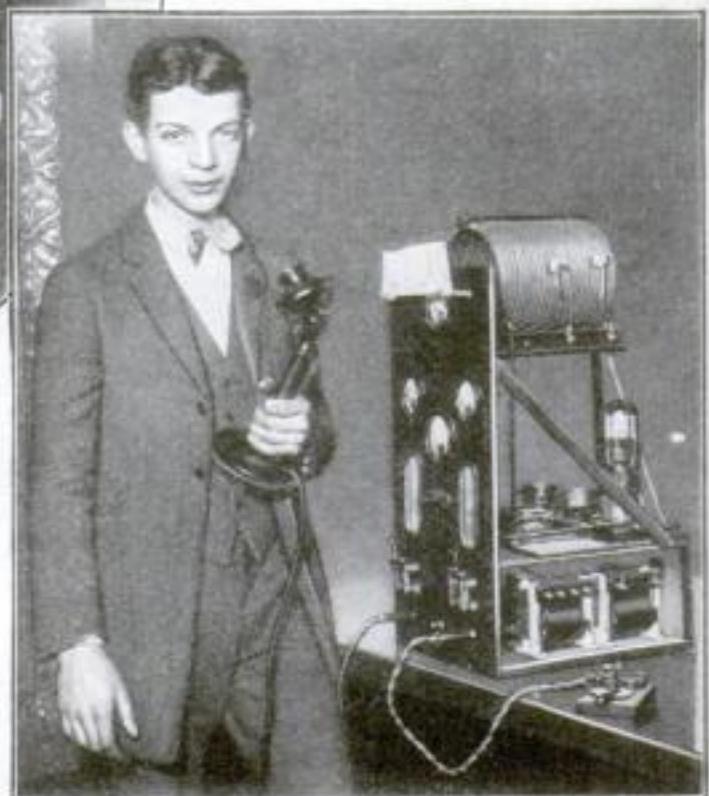
At a cost of \$75, Frank Carrington, aged 72, a farmer of Washta, Ia., has constructed his own astronomical observatory. The revolving roof can be turned in any direction desired



Using only a cross-cut saw, an improvised hacksaw, and a knife, Earle F. Olson, a young pianist of Galesburg, Ill., constructed the home-made baby-grand piano with which he is shown. The instrument contains 5500 pieces, each shaped by hand. Olson spent 3650 hours working at the task



The odd chimney-like apparatus above is a home-made instrument designed to measure the wind resistance in driving a car. It was designed and built by Clarence S. Bruce, an employee of the Automotive Power Plant Section of the United States Bureau of Standards at Washington, D. C.

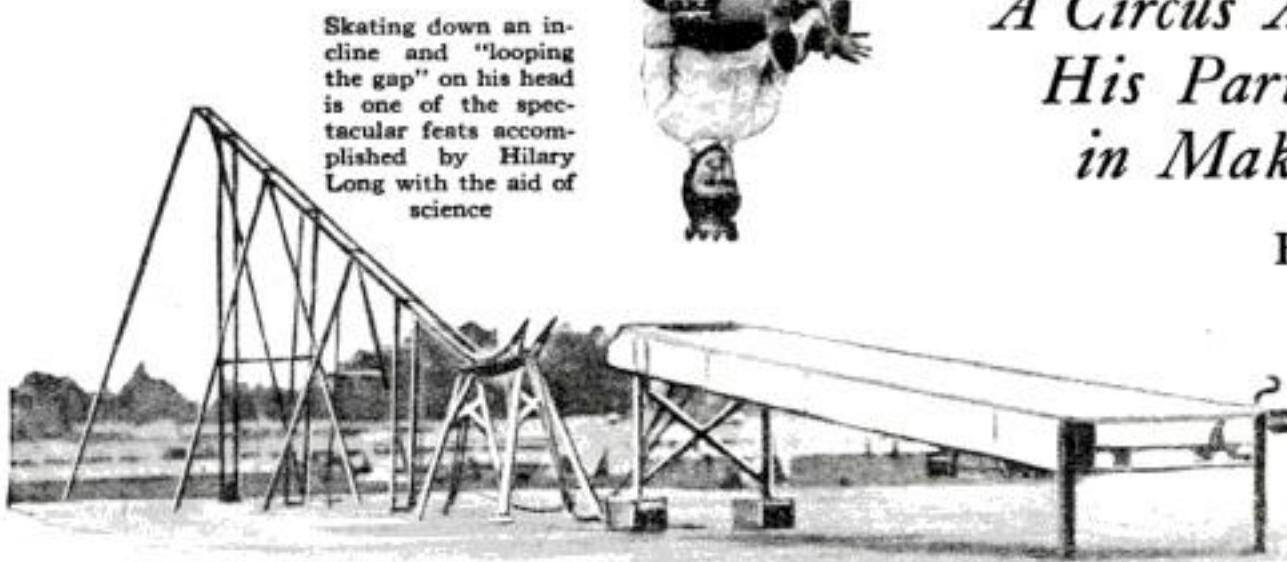


Here is Harry Belock, youthful member of the Brooklyn, N. Y., Radio Club, with the 100-watt radio transmitter he built during his spare hours. He claims his station, designated 2 AVC, has a transmitting radius of 2600 miles when conditions are most favorable

How I Became a Daredevil

A Circus Acrobat's Own Story of His Partnership with Science in Making the Big Thrills

By Hilary Long



Skating down an incline and "looping the gap" on his head is one of the spectacular feats accomplished by Hilary Long with the aid of science



I AM not afraid to slide down a steep chute and "loop the gap"—on my head. I do it twice a day. I am not afraid, because I know I am safeguarded by unalterable principles of science that I have trained my body to obey.

The greatest circus daredevils are close students of nature's physical laws. And the most perfect, most thrilling spectacles of the sawdust ring are those in which the principles of science have been applied most painstakingly. In fact, practically every law of physics is brought into play in the making of a great circus—the principles of gravity, equilibrium, acceleration, velocity, centrifugal force, and the rest. Likewise, practically every branch of physics has its use—the optical, with which the magicians perform their marvels; electricity, the secret of the fire-eaters; acoustics, the aid of the eccentric musicians; mechanics, the ready tool of every trick-playing clown and the basis for the most hair-raising thrillers conceived by clever inventors.

Even when I was a boy of seven, practising my first circus stunts with crude, homemade apparatus, I learned to recognize the unalterable laws of physics, even though I did not know their names. When my father forbade me to join the circus, I acquired my first early training by daily practice in the family barn. And with practice came confidence—the confidence based on a growing acquaintance with scientific principles.

How is it possible, you may ask, that I can roller-skate on my head down a chute inclined at an angle of 60 degrees, jump across an open gap and land safely on my head? It is a simple matter of equilibrium; I have applied the laws of acceleration and gravity to my balanced, speeding body. If I should defy these laws for the fraction of a second, disaster might result. But I never defy them.

Equilibrium is one of the basic problems that must be solved by the circus daredevil. To preserve the equilibrium

of any body or object, the vertical line passing from its center of gravity to the earth must pass through its resting base, or between its bases, if there are more than one. In man, the normal resting bases are the feet, and the line of gravity passes between them.

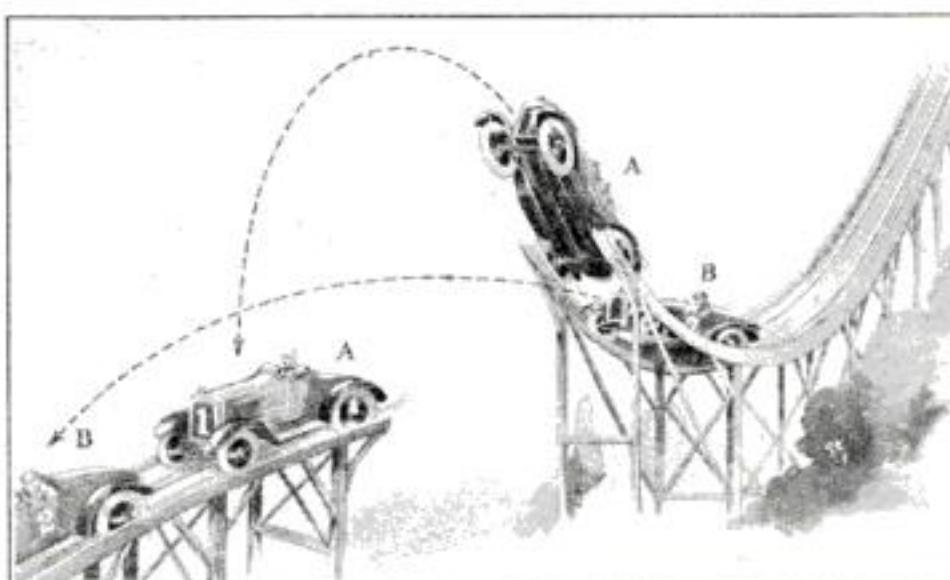
NOW, in order to preserve equilibrium, Nature prefers a wide resting base. The wider the better. That is why a sailor, on a rocking ship, instinctively spreads his feet far apart. But as my job is to entertain and thrill my audiences, I reverse the proceeding. Instead of making my base of support as wide as possible, as Nature prefers, I make it as small as is humanly possible. If, while I stand on my head for my spectacular upside-down slide, some one should drop a line equidistant between my legs, the line would pass through my head and go straight to the ground in response to the pull of gravity toward the center of the earth. My center of support is not between my feet, as it is when I am standing; but it is



Hilary Long, daredevil, of the Ringling Brothers Circus, who says his safety lies in his knowledge of the laws of physics

my problem is still more complicated. The instant my body, in this upside-down position, begins to move swiftly down an inclined plane, another factor comes into play—acceleration. If I am to preserve my balance on its small support, the line through my body no longer can be straight toward the center of the earth, but must be inclined forward to a degree, depending upon the acceleration.

Just how much this inclination should be, I can determine by mathematical calculation; but I can put these findings into practice only by controlling my body perfectly to obey them. Nature is a mistress who permits no trifling. I do not juggle with Nature; I simply reach an understanding with her. And so I get on very well with a half-inch foundation instead of the two-foot foundation of the sailor.



The aerial automobile race, a mechanical thriller made possible by accurate calculation of distances and timing. Two small automobiles, A and B, race down an incline and loop the gap. Although A starts first, B finishes first, as shown. This is because A is made to go higher at the take-off, and so must travel a longer path to the receiving platform

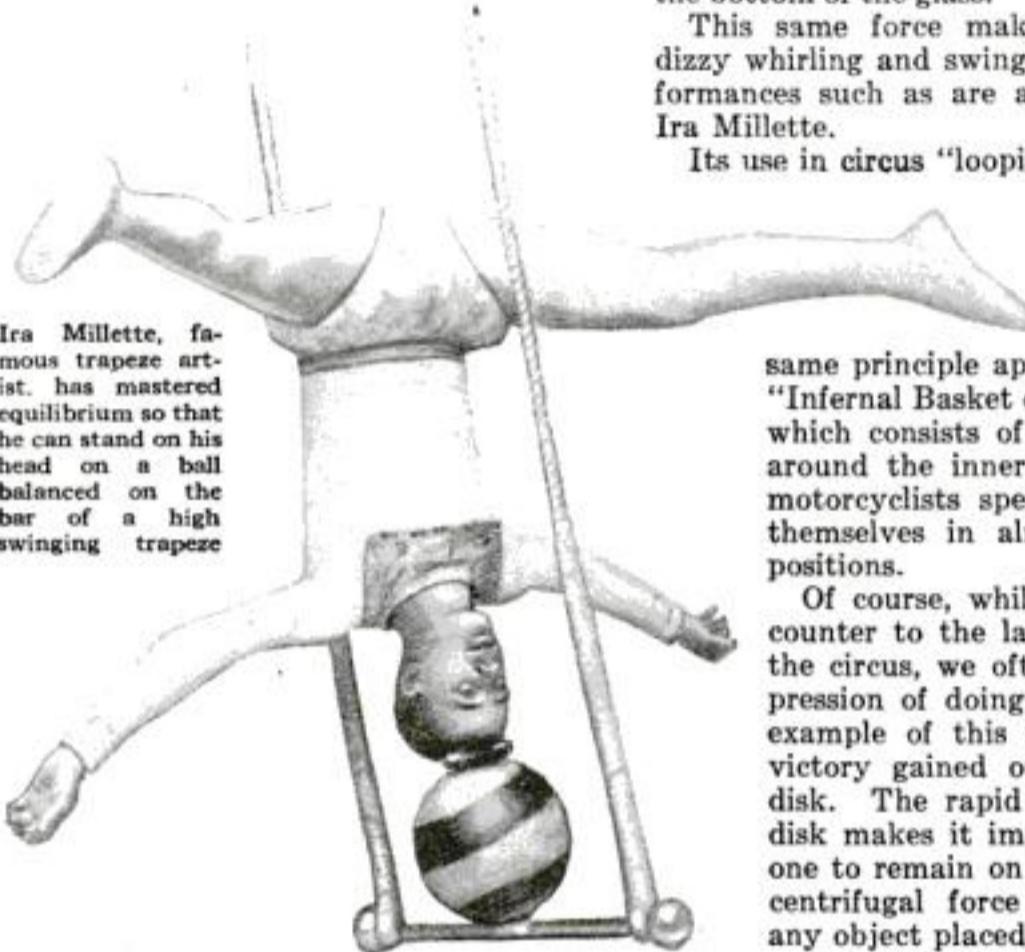
a point the size of a dime at the crown of my head!

My efforts, like those of other balancers and aerialists, are toward reducing my base of support to the least possible space. But in my upside-down coasting stunt

former's body, such as the hand, chin, forehead or shoulder. You often have seen a juggling acrobat balance on his chin or nose a long pole, at the top of which may be balanced another object, or even another performer.

The longer the pole is, the more amazing the feat seems to be. Yet actually the reverse is true. A long pole is far easier to balance than a short one, for the reason that a slight movement of the center of gravity can be compensated for by a comparatively slight movement of the support.

MORE difficult than balancing an object, is the balancing of a performer's body while poised on an object. If you ever have tried to ride a log floating in the water you will realize just how



Ira Millette, famous trapeze artist, has mastered equilibrium so that he can stand on his head on a ball balanced on the bar of a high swinging trapeze

difficult it is. In this field the circus equilibrist has learned to perform feats that are almost unbelievable.

Ira Millette, the American aerialist who does unusual feats of swaying, swinging, and twirling high above the ground on a double trapeze, is a master of balance. In one of his acts he balances himself upside down on a ball which, in turn, is balanced on the bar of a trapeze swinging high above his audience.

EQUALLY as important as balancing for the aerialist is the exact timing of movement so that the acrobat's flying body and the swiftly moving apparatus will come together with clocklike precision. Jennie Rooney, one of the most skillful of American trapeze performers, rightly says that time, balance, and strength form the tripod that supports the successful circus daredevil.

In her whirling leaps high in the air, as she flings herself from a trapeze to her partner's outstretched hands, Miss Rooney is able to calculate her own movements and those of her partner to a split second. One miscalculation might mean a disastrous fall. Strength counts tremendously, too. Miss Rooney looks like a young girl just out of school. Yet she has the strength of two women. She proved that not long ago when she fell from a trapeze 40 feet high, caught a rope halfway down and clung fast to it. That was one of the most remarkable feats ever performed by a woman of the circus.

Another law of physics that all aerial

POPULAR SCIENCE MONTHLY

performers must understand is centrifugal force—the force that exerts itself ever away from the center. This law is employed in all the audacious circus acts grouped under the general term of "looping."

A simple example of centrifugal force can be witnessed by any one. Fill a glass with water. Whirl it rapidly in circles outward, the circles growing larger and larger. The water will remain in the glass, even when it is in an upside-down position. Centrifugal force, moving from the center outward, presses the water against the bottom of the glass.

This same force makes possible the dizzy whirling and swinging trapeze performances such as are accomplished by Ira Millette.

Its use in circus "looping" was applied for the first time 24 years ago by an American cyclist. The

same principle applies also in the "Infernal Basket or Death Trap," which consists of a large basket, around the inner sides of which motorcyclists speed, maintaining themselves in almost horizontal positions.

Of course, while we cannot go counter to the laws of nature in the circus, we often give the impression of doing so. A striking example of this is the apparent victory gained over a revolving disk. The rapid rotation of the disk makes it impossible for any one to remain on its surface: for centrifugal force flings outward any object placed upon it.

But if a man, stepping on the whirling disk, runs in a direction opposite to that of its rotation and slightly toward the center, it will support him. This has been accomplished by several performers on roller skates. It would seem to be a defiance of the law of centrifugal force,

while really it is a demonstration of balance.

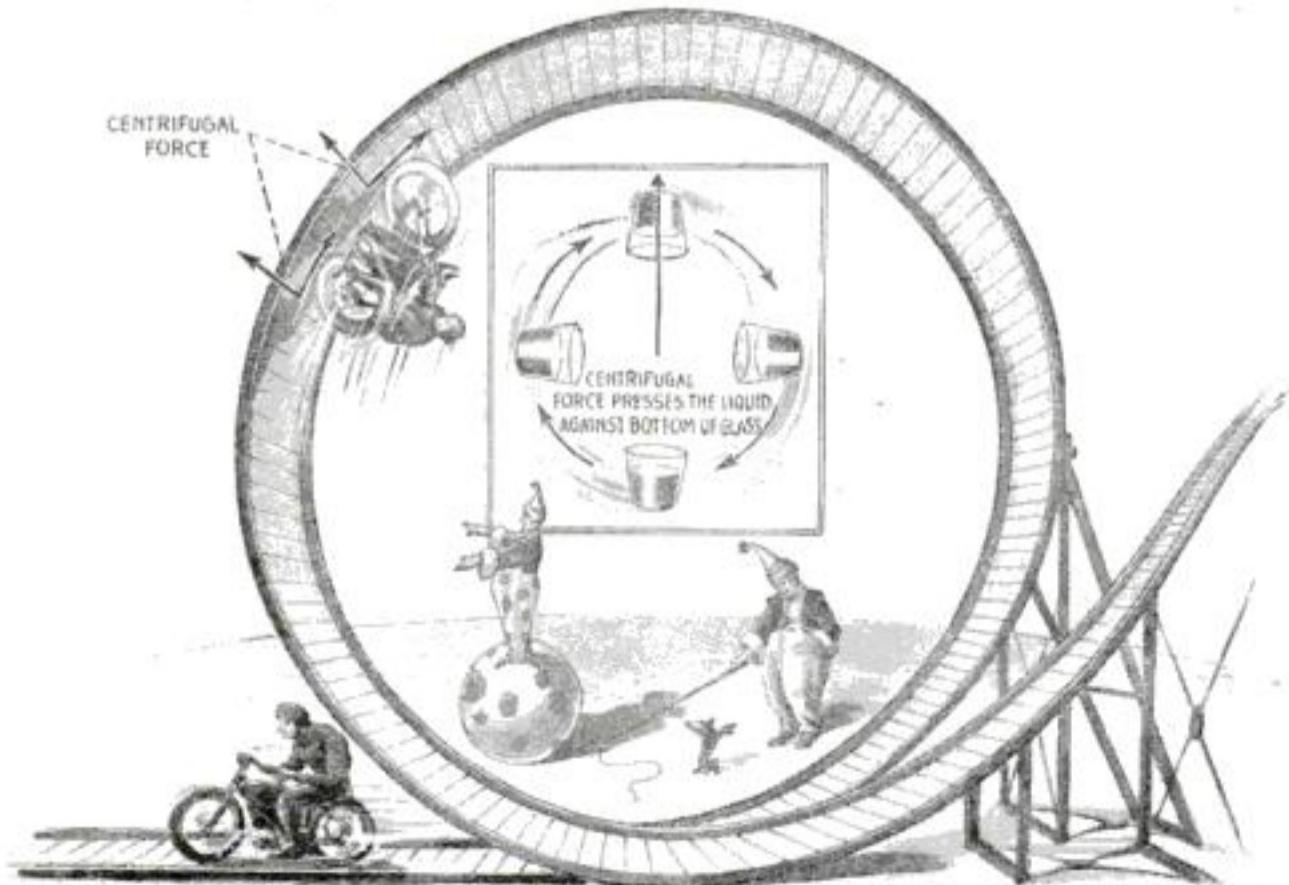
Accurate timing, so important to the aerial performer, is one of the secrets of my headlong "loop the gap" stunt. Likewise, it is the secret of some of the most thrilling mechanical spectacles of the circus. One of these is the aerial automobile race, invented not long ago by Emile Noiset, who was one of the first to try "looping the loop." Two small automobiles dash down a steep inclined runway, leap through the air, and land on all four wheels on a receiving platform.

ONE car starts the mad race slightly ahead of the other; yet, strange to say, the car that starts second arrives at the finish first. How is such a paradoxical result possible?

The secret lies in timing. In its leap through the air, the car that starts first is made to describe a higher arc than the second car, which means, of course, that the first car must travel a longer distance—a distance great enough to make it arrive on the other side of the gap behind the second car.

The circus performer knows that it is just as important to keep the apparatus and machinery with which he works in perfect operating order as it is for him to observe and obey the laws of physics. This applies as well to the machinery of his body. For successful achievement he must acquire and preserve perfect health and strength. He must be clear-headed always. His nerves must be steady; his supple muscles trained to obey with perfect movement every order flashed from his brain.

NOT once in a quarter century of experience in the circus have I known the sensation of fear. Yet it is not reckless bravado that makes the circus daredevil fearless. His fearlessness is grounded in the calm confidence that comes with knowledge of physical laws, obedience to them, and firm reliance on their steadfastness.



The thrilling motorcycle "loop the loop" is made possible by applying the law of centrifugal force—the same force that keeps the water from spilling from a glass that is swung in a circle.

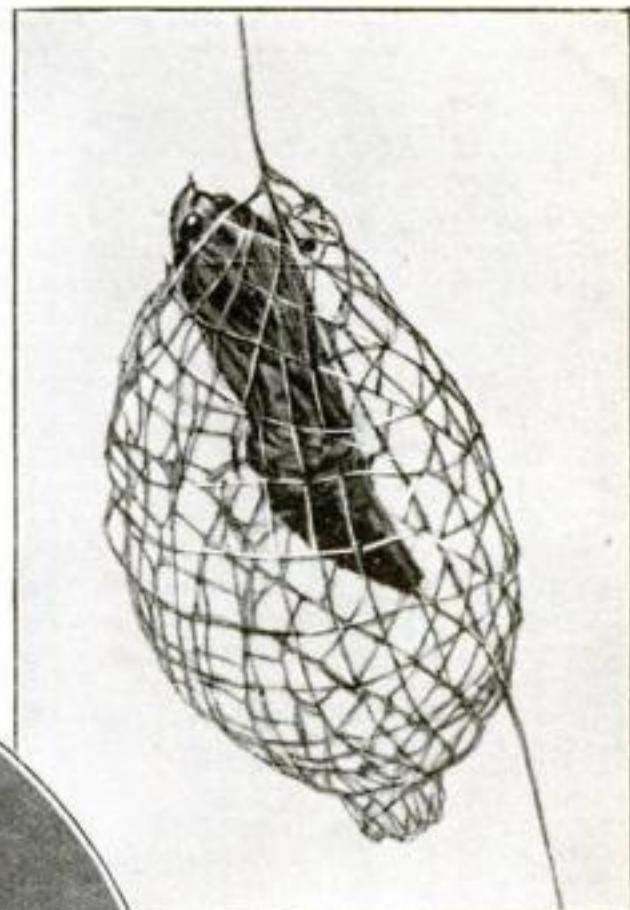
Just as centrifugal force presses the water outward against the bottom of the glass, so it holds the cyclist against the track while he is traveling at a terrific speed upside down

Masterpieces of Insect Architects

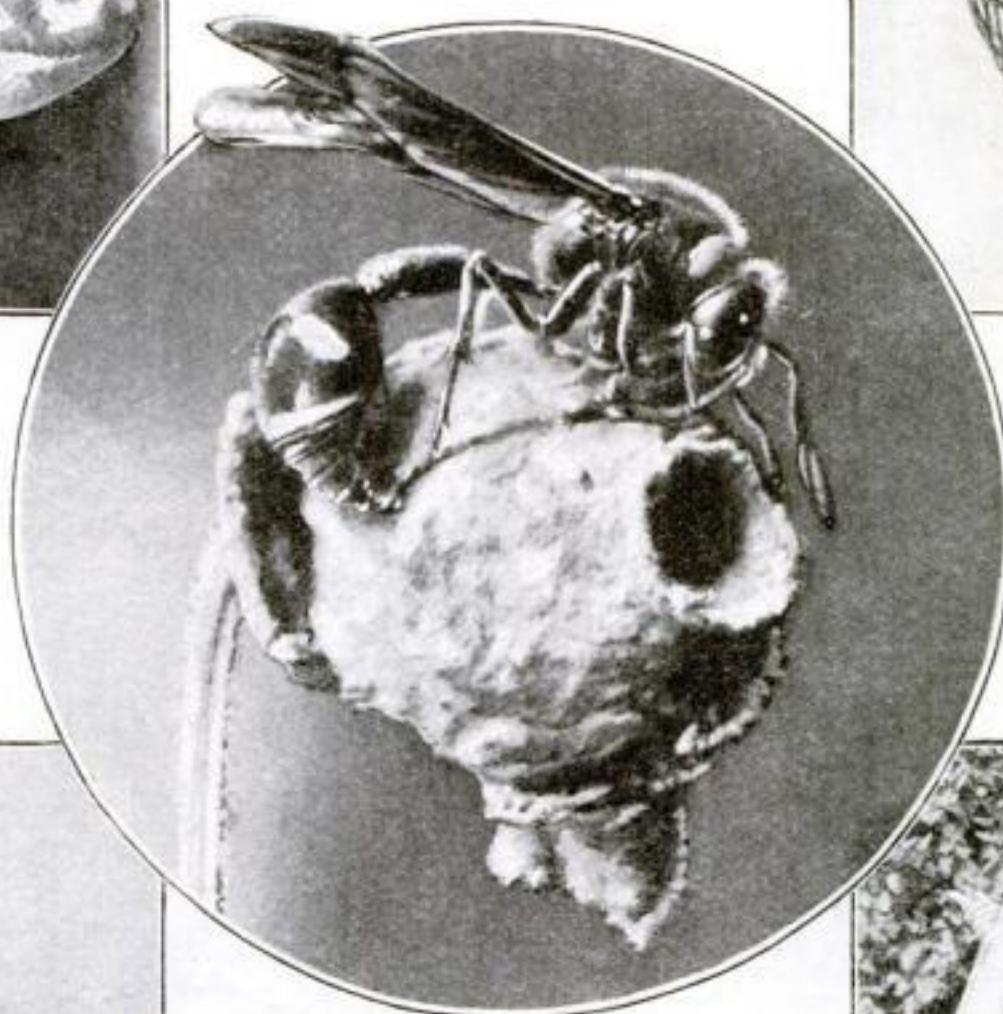


The master artist of the insects is the Painted-Nest Wasp of the tropics. Its nest, hung from a twig, is in the form of a flattened ball of dark reddish-brown pulp curiously streaked with patterns of white, pink, and green. At the side of the nest is a circular entrance.

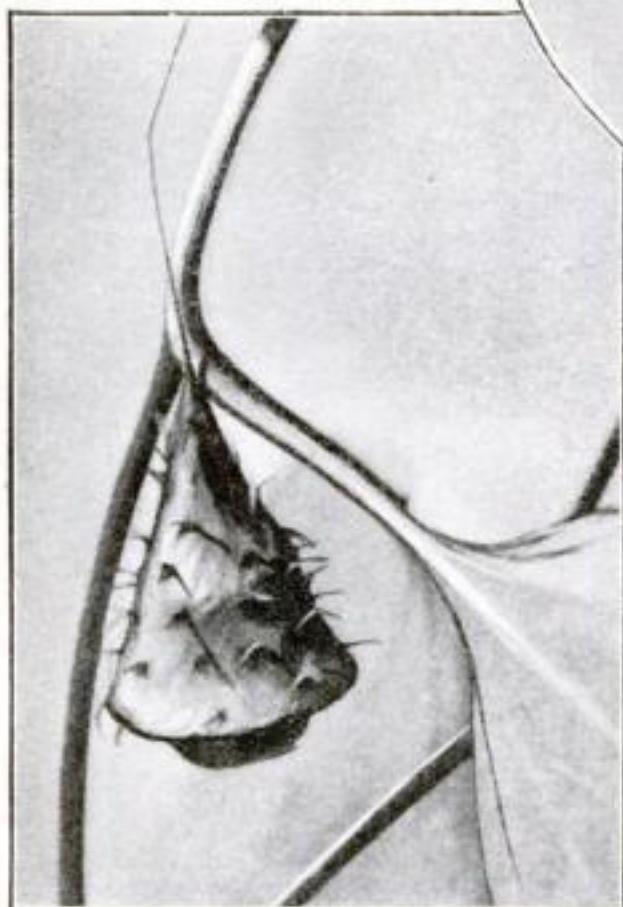
THE insect world, like the world of men, has its master architects and builders, its painters and decorators, carpenters, and masons. And many of its odd structures are marvels of economy, safety, comfort, and beauty. In the great South American jungles, where the air is warm the year round, the insects have attained extraordinary skill in the construction of their homes. There are found the masterpieces of their architecture, adorned with wonderful designs and colors, and fortified against invading enemies. A few of these structures, photographed by Paul Griswold Howes, assistant curator of the Bruce Memorial Museum, Greenwich, Conn., are reproduced on this page.



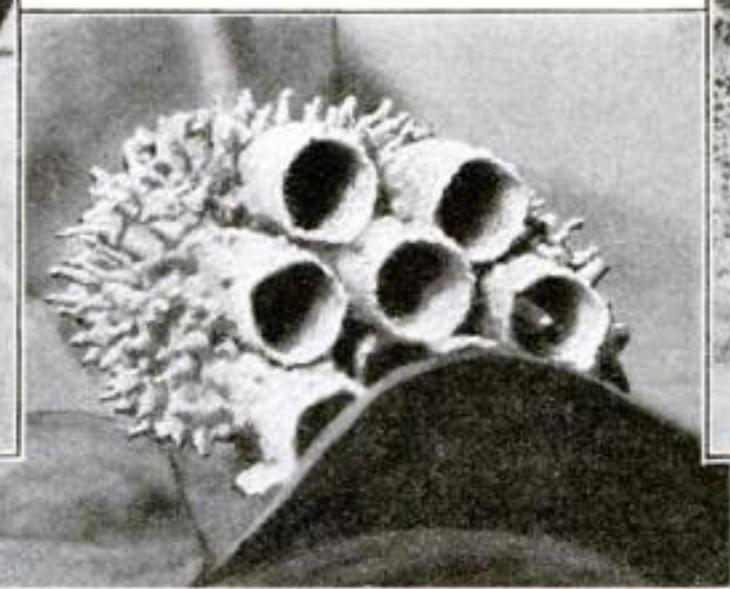
As a protection against myriad jungle murderers, the caterpillar of certain species of butterflies suspends itself from a leaf by a long, strong thread. Having done this, it weaves a beautiful silken basket of delicate mesh, less than an inch long. The photograph shows it greatly enlarged.



This Mason Wasp, called the *Eumenid*, is a potter of remarkable skill. Above is one of the many-colored jugs of clay in which its eggs are hatched.



An ingenious armored house in which the cocoon of a Tropical Moth is protected from its enemies. It is a silken cone, half an inch high, covered with several dozen thorns made of the finest silk. The cone is hung from a silk thread 10 inches long attached to the apex. It appears neither to be edible nor to offer good footing, and so is left alone by the insect's enemies.



This delicate nest of the tiny Trypoxyylon Wasp Mr. Howes says is one of the most exquisite he has ever found. The cells of clay where the young wasps are raised, are more delicate than tissue paper. The entire outer surface of the nest, which is shown four times its actual size, is covered with clay spines.



A huge "apartment house" built by the Social Wasps that live in great communities in the tree tops of Colombia jungles. The white pulp nest, three feet long, is as tough as the finest papier-mâché, beautifully glazed, and as white as snow. Within are tiers of paper cells. In obtaining the nest shown above, the limb supporting it was shot through and the nest dropped.

New Vistas of Science

The Latest Discoveries and What They Mean to You

A NEW tool with a most amazing variety of uses has just been put in the hands of science through the development of a method of producing clear fused quartz in quantities in the laboratories of the General Electric Company at Lynn, Mass.

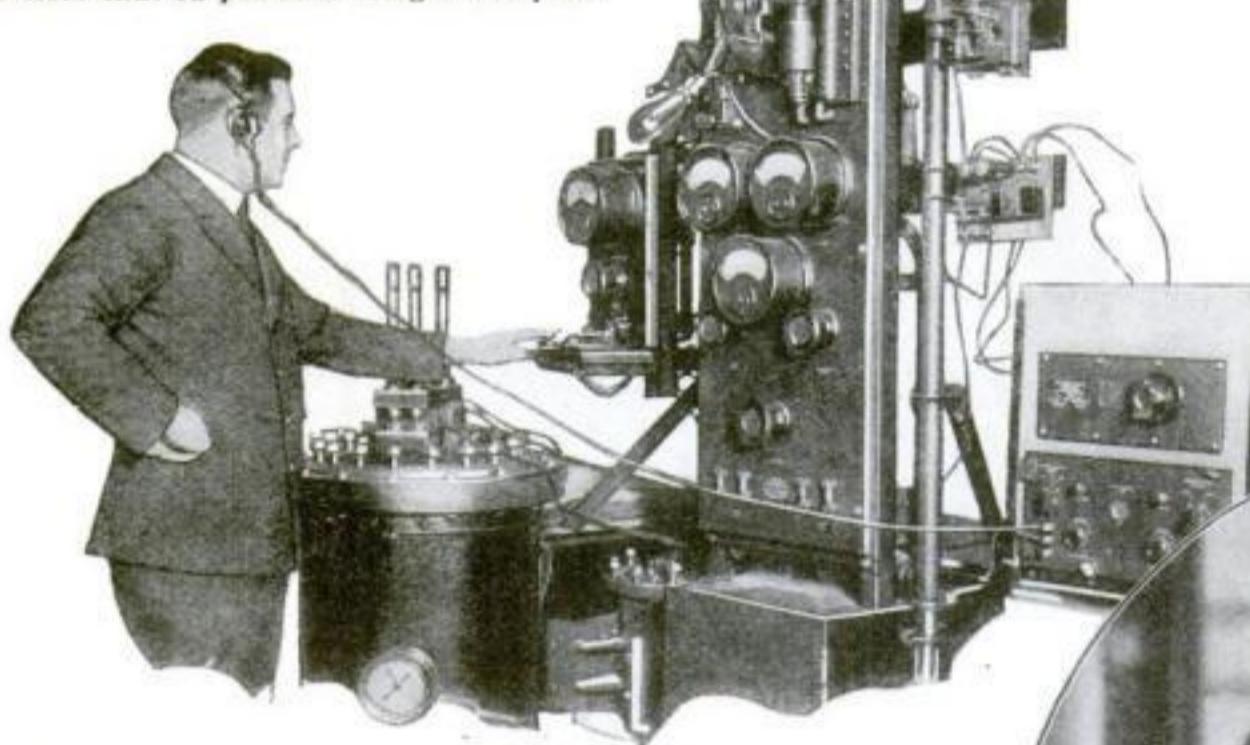
While the material itself has been manufactured in small quantities for many years, the new electric furnace, invented by Dr. Edward R. Berry, assistant director of the Thomson research laboratory of the General Electric Company, transforms it suddenly from a substance too valuable for general use into a material that eventually may become as plentiful as window glass, which it resembles.

Unlike window glass, though, fused quartz is almost absolutely transparent; so clear that 92 per cent of light will pass

from heat, making it an optical material of unusual quality for such purposes as the lenses of telescopes, microscopes, cameras, or moving-picture projectors.

New Remedy for Pneumonia

FROM the Harvard Medical School recently was announced the discovery of a remedy which has been used with success in the treatment of many sufferers from lobar pneumonia, who represent about 25 per cent of pneumonia patients. Medical men have expressed the opinion that under favorable conditions the new treatment may reduce the mortality from lobar pneumonia by 25 per cent or more.



A powerful aid to safe navigation is embodied in the instrument shown above, known as a "submarine oscillator and depth finder," perfected by research engineers of the U. S. Navy. Sound waves projected through the water by the apparatus strike bottom and are reflected back to an instrument on the ship, which records the exact time consumed in the round trip and so computes the depth of water under the vessel. The apparatus also determines the distance of another ship, thus greatly aiding the navigator to avoid the danger of collision in a heavy fog.

through it. Ordinary glass permits the passage of only 35 per cent, while the transparency of the best optical glass is only about 65 per cent.

More important still, unlike ordinary glass, it does not filter out the ultra-violet rays, which medical science knows to be so potent a germicide. And since it transmits the heat of light virtually without loss, it makes possible the construction of sun rooms in which invalids will receive the full benefit of the curative rays of the sun while shielded from the cold of outdoors.

Further, its peculiar quality of transmitting light in much the same way that electric current flows through a wire may permit physicians to carry the beneficial ultra-violet rays to parts of the body that usually are inaccessible. If a rod or tube of fused quartz is bent or curved, the light and heat still travel from one end to the other.

Unlike glass, the fused quartz, prepared from rock crystals that exist in virtually inexhaustible quantities, does not crack

The discoverer of the new treatment, Dr. Lloyd B. Felton, is only 32 years old. What he did was to purify the ordinary horse serum, used in the treatment of pneumonia, obtaining a white crystalline substance believed to be fatal to the pneumonia germ. This pure serum does not produce the chills, fever, and "serum sickness" that more often than not follow the use of horse serum and made it of doubtful value in the treatment of pneumonia.

What Bad Roads Cost You

IT IS obviously more expensive to run an automobile over poor roads than over good ones. Just how much difference it actually makes, though, is astonishing.

Taking all expenses into consideration—gasoline, oil, tires, and repairs—motoring over unimproved roads is more than 50 per cent more costly than rolling over smooth highways.

This fact was disclosed in a recent test conducted by the Department of Highways of the State of Kentucky. Sixty-two light cars of the same make and model were used in the test, one group being operated for a period on good roads, the other on bad.

The upkeep of cars that ran on the good roads averaged 4.22 cents a mile, while each mile on bad roads cost 6.72. In gasoline alone each mile run over the bad roads cost 2.3 cents; on good roads the cost was 1.7 cents.

Strange Birds that Bray

NATURE'S oddities seem to be without number. An expedition of the American Museum of Natural History, searching for rare bird specimens in South America, found penguins in the jungle. This was remarkable enough, for penguins always were associated with the ice wastes of the Antarctic. But these tropical penguins bray like a jackass.

Another queer find was called by Dr. Frank M. Chapman, leader of the expedi-



Dr. E. B. Krumbhaar of the Philadelphia General Hospital, an expert in cancer research work with radium, recently reported that scientists now are able to produce cancer in mice at will. A few daily applications of isoprene tar on a mouse's back, he says, result within six months in a wart-like mark that becomes a cancer

tion, "a case of evolution in progress while the species is still in existence." This consisted of two specimens of the steamer duck, one from inland and one from the coast.

The coast specimen lives on crustacea and other small life. It has no enemies and does not have to search for food, so it has forgotten how to fly! It uses its wings merely to aid it in swimming.

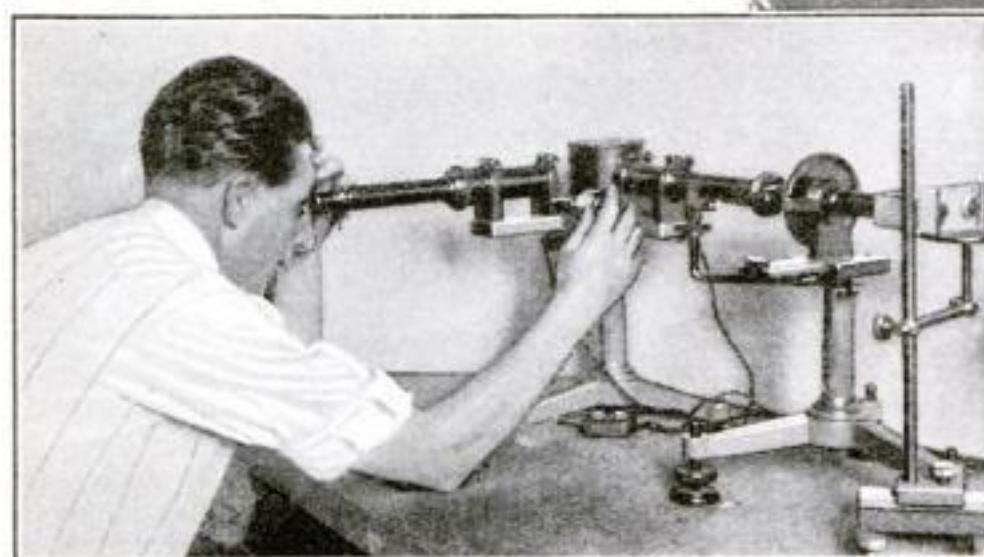
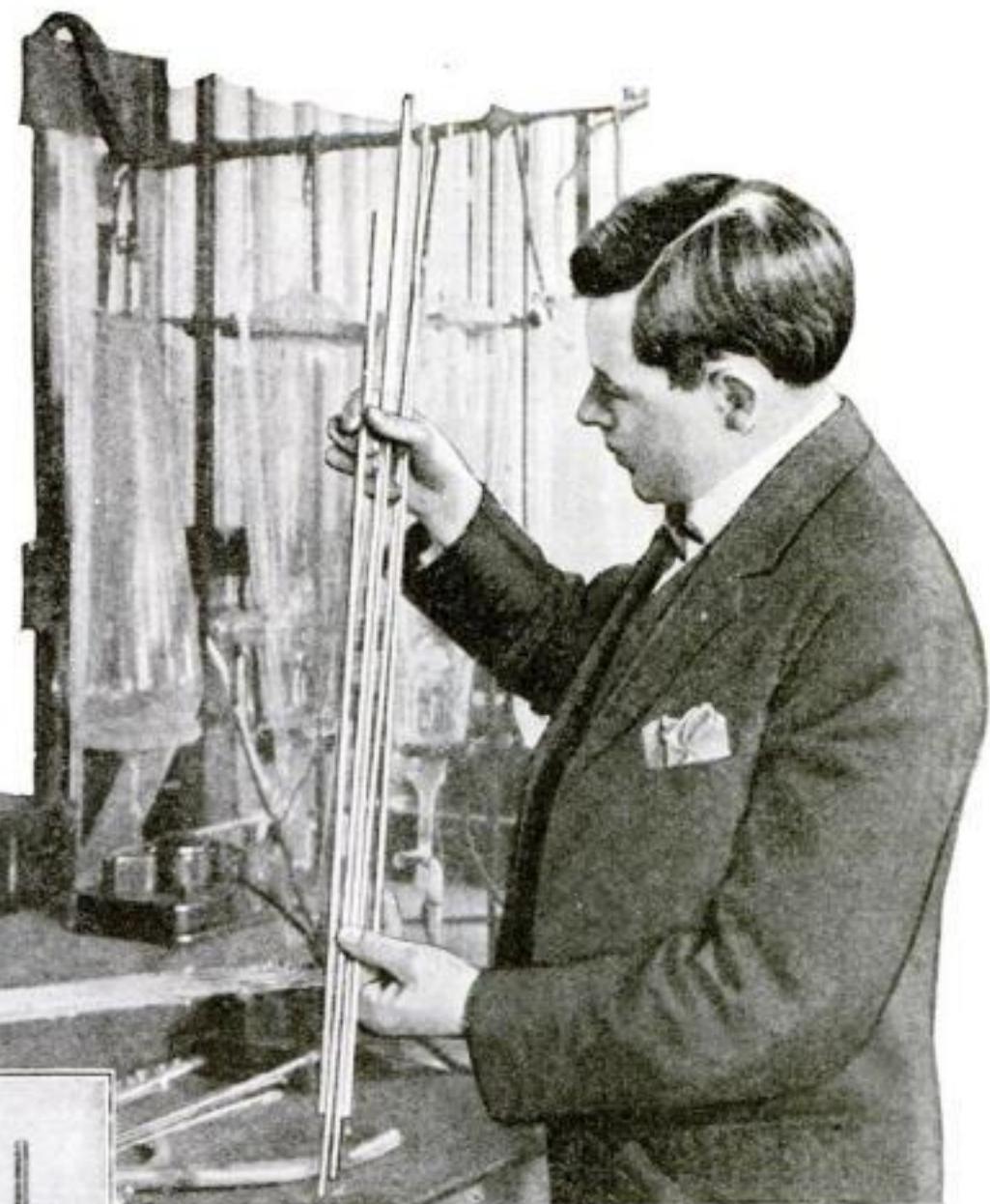
Its inland brother, however, must fly above the tall trees to reach the lakes where it finds its food, so it uses its wings as other ducks do.

Will the Sun Cook for Us?

HARNESSING the sun is an old dream of inventors, a dream that has approached realization many times through the construction of sun motors, but not yet has been fulfilled. Recently several more or less successful attempts have been made to persuade the sun to render to man additional service beyond the light and heat it customarily supplies.

No less a person than Dr. Charles G. Abbot, of the Smithsonian Institution, who is probably the world's foremost authority on the sun and its ways, was responsible for one of these attempts. At Mt. Vernon, Calif., a few weeks ago, Doctor Abbot constructed a solar cooking range in which he intended to broil steaks and bake bread by concentrated sunlight. Apparently the range was working well—a thermometer test showed a temperature of about 350 degrees within its oven—when some oil was spilled and the stove was destroyed by fire. Doctor Abbot is rebuilding the range, and expects to demonstrate soon that food can be cooked

Tubes of clear fused quartz, the most transparent solid known to man, are shown here in the hands of Dr. Edward R. Berry. By the perfection of a new electric furnace in the laboratories of the General Electric Company he has succeeded in producing unprecedented quantities of this extremely useful material, as described on the opposite page



without coal, wood, gas, oil, or the other fuels commonly used.

At about the same time a San Francisco inventor was demonstrating a solar heating plant in which the rays of the sun, reflected from mirrors and focused through lenses, brought tremendous heat to bear on a small spot. The inventor claimed his apparatus was capable of melting diamonds. Another Californian, utilizing a somewhat similar principle, has developed a reflecting apparatus that is said to concentrate sufficient solar heat to melt the ores of metals.

Scientists in the Color Laboratory of the Department of Agriculture are conducting researches to produce superior American dyes. At the left is W. C. Holmes, looking through a newly perfected machine used to analyze stains

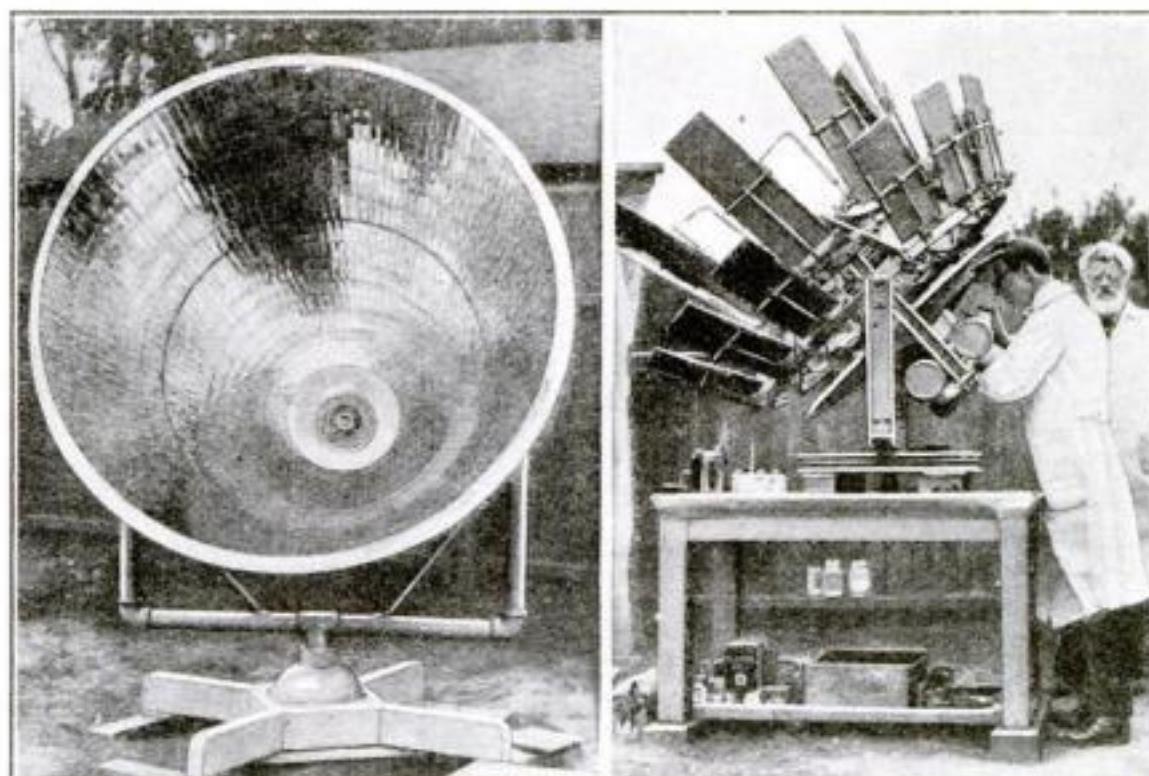
Ordinarily, sandstone will withstand a pressure of not more than 8000 to 9000 pounds a square inch. After the sulphur treatment, however, its strength of compression is increased to 30,000 pounds, or about 300 per cent. This is due to the fact that the porous sandstone soaks up large quantities of the sulphur.

Cement immersed in melted sulphur also has been found to gain remarkably in strength.

Tests are in progress to determine how well the sulphur-imregnated sandstone withstands exposure.

A Life-Saver

ONE of the deadliest perils to the motorist—the poisonous carbon monoxide gas discharged from the engine exhaust—appears to have been conquered. Dr. Miller Reese Hutchinson, famous inventor and former chief engineer of the Edison laboratories, announced recently the discovery of a chemical compound which, when mixed in small and inexpensive quantities with commercial gasoline, not only virtually eliminates danger from this source, but prevents



Two views of a new solar furnace invented by Marcel Moreau, Jr., of San Francisco. Multiple mirrors and lenses are used to

concentrate the sun's rays and develop a heat of 15,000° F. The picture at the right shows the inventor and his father

dous strength, much cheaper than granite.

By soaking sandstone in melted sulphur for several hours, it is found that it becomes as strong as the best granite.

carbon deposits in the engine cylinders. An effective mixture, he says, is in the proportion of two or three ounces to five gallons of gasoline.

Super-Stone

THE U. S. Bureau of Standards has been conducting interesting tests recently to supply engineering science with a new building material of tremen-

Your Meals and Your Health

By Walter H. Eddy, Ph.D.

Professor of Physiological Chemistry, Teachers College, Columbia University

ARE you afraid to eat lobster with your ice-cream? "Such an idea is absurd," says Doctor Eddy, expert on nutrition. "The dangers in food lie not so much in what is eaten as in what is not eaten."

"Your food should be palatable," he says; "which is equivalent to saying that a dietitian's idea of a good meal is the same as your own. The familiar story of a woman losing her husband's love because of poor cooking is more truth than fiction."

The human body is an engine, the food we eat being the fuel. Our thinking, our work, our strength, and our outward appearance all depend upon diet. Faulty meals are responsible for more than one half the world's disease.

NOT long ago 200 American families were canvassed as to their diet, and full details obtained of the meals they had eaten through a considerable period. Almost without exception the diets were deficient in important constituents necessary for the support of life.

Now, there is no reason why this should be the case. Correct eating is quite as easy to achieve as incorrect eating, and is a great deal more satisfactory to every one concerned. A correct diet produces good health and increases the chance of longevity. And yet these desirable ends are not won at the cost of the self-denial that is associated in many minds with the use of the word "diet."

As a matter of fact, a proper diet is made up of meals that are good not alone because of their physical benefit, but good in the popular sense as well. Moreover, a proper diet does not cost any more, nor require any more work on the part of the person who must prepare the food than does the unscientific and unsatisfactory way of eating that is the rule in so many homes.

Most people remember when the popular idea about diet might have been summed up about as follows: Some foods—say chicken, vegetables, and cereals—were "digestible," and hence should be eaten freely. Other foods—hot bread, for example, pies, hard-boiled eggs, and shellfish—were "indigestible," and hence were to be eaten sparingly if at all. Also, certain foods eaten with other foods were supposed to form "bad combinations." Classic examples of this last notion were the combinations of lobster and ice cream or pickles and milk. Either of these combinations was supposed to lead inevitably to disastrous consequences.

THE experiences of modern dietitians has shown these ideas about harmful food combinations to be entirely absurd. Foods are not antagonistic to one another. There are really no bad food combinations—in the sense, anyway, that two foods such as ice cream and lobster form a team that is fatal to digestion.

If any one ever really became ill after eating ice cream and lobster, it was because he ate too much or was poisoned by impurities—either one of which might have happened to him after eating ice cream alone, or lobster alone. If there are bad food combinations, they are made so more because of what they lack than because of what they contain, and these become good combinations as soon as you

For years Doctor Eddy has been studying human beings and the food they eat. Recently he attracted wide attention by isolating "vitamin D," one of the mysterious and elusive vitamins so essential to the support of life.

In the article beginning on this page he outlines in a simple, understandable way the scientific principles of nutrition. He translates the calories, vitamins, proteins and carbohydrates of the dietitian's laboratory into plain, non-technical language.

Doctor Eddy shows you how to eat what you like and yet promote your health and happiness. What he has to say is important to every reader of this magazine.

—THE EDITOR.

supply the elements that they lack.

Or, to put it in another way and show how simple this whole diet question really is in its practical application, there is nothing wrong with the foods you are accustomed to eat, except that, if you're like the vast majority of people, you probably do not eat those foods in the proportions and amounts required by the chemistry of your body.

To take a specific example, a dinner consisting of broiled steak, fried potatoes, bread and butter, pumpkin pie and coffee probably would impress you as being a good meal. It would satisfy your appetite and supply you with enough energy to do your work. And yet, although not so imperfect a meal as others I might mention, it is not actually a good one, for it lacks at least one element essential to the welfare of the body. Add a green vegetable—spinach, string beans, or something of the sort—or a salad, and you have supplied the element that is lacking, and have made it a satisfactory meal.

ONE reason for this is that your body requires a small amount of mineral salts each day—particularly salts containing calcium and phosphorus. These

doubted reason why so many children in this country are afflicted with rickets, and why so many people have bad teeth.

THE first purpose of food is to supply the body with energy in the form of heat. This is measured in calories, just as coal is measured in tons. Getting the proper amount of calories each day, however, does not solve the food problem. Restaurants and cookbooks frequently give the number of calories certain dishes contain, but that doesn't mean everything. Any food chemist could compile a "diet" consisting of alfalfa, chicken corn and linseed oil that would contain all the calories the human body requires, but you couldn't use such a diet. The human body is not designed to digest and utilize hay and linseed oil.

The human body, however, is designed to digest and utilize food of the kind you always have been accustomed to eating, and it is from those foods that you must select your diet. Science divides those foods into four classes—proteins, which are meat or meat substitutes; carbohydrates, that is, sugar and foods of a starchy sort, such as potatoes; fats, and mineral salts. Proper



Showing the amount of staple food consumed by the average man in his lifetime. People of the United States spend \$49,000,000 for food daily

are present in green vegetables and milk in proper proportions. Now, except for the small amount of milk that probably would be placed in the coffee, or would be used in making the pie, until a green vegetable was added, the meal I detailed above was lacking in the calcium, which is of especial importance in the promotion of bone growth. This was the principal deficiency shown in the 200 diets to which I referred above—a lack of green vegetables and milk. And it is the un-

selection from among these four elements solves the problem of proper eating. One trouble with Americans is that they may seek to supply their bodies with energy from proteins alone. They may eat too much meat.

You may apparently thrive on a diet containing too much meat for many years, but such a diet is almost certain to lead to dangerous disorders, for it causes an acid condition of the body that may accelerate rheumatism, premature old age, harden-

ing of the arteries, and even apoplexy. The amount of meat that should be eaten in one day by the average person should not exceed the equivalent of half a pound of beefsteak, and you probably will find one meat meal a day sufficient. Or you may get the amount of protein your body needs in a day from any of the following: two quarts of milk, six eggs, or a third of a pound of cheese.

THIS daily allowance of protein may be said to supply the nucleus of your diet. Add to it fats, carbohydrates and mineral salts in amounts sufficient to form meals of your accustomed size, and your diet problem is virtually solved.

The one precaution to be taken, though, is to avoid excessive eating of fats and carbohydrates. Americans are not likely to overeat on fats, but many persons do eat too much sugar and starches, which ferment in the stomach and cause headaches, physical sluggishness, and other ills. In fact, there are many persons who probably never have tasted strong drink in their lives who actually are suffering from an intoxication similar to that produced by alcohol, due to injudicious eating of sugar and starches. This sort of food intoxication has all the narcotic effect of whisky without its exhilaration.

A simple way to avoid the danger of overindulgence in starches and sugar is to use green vegetables to supply much of the bulk of the food you are accustomed to take

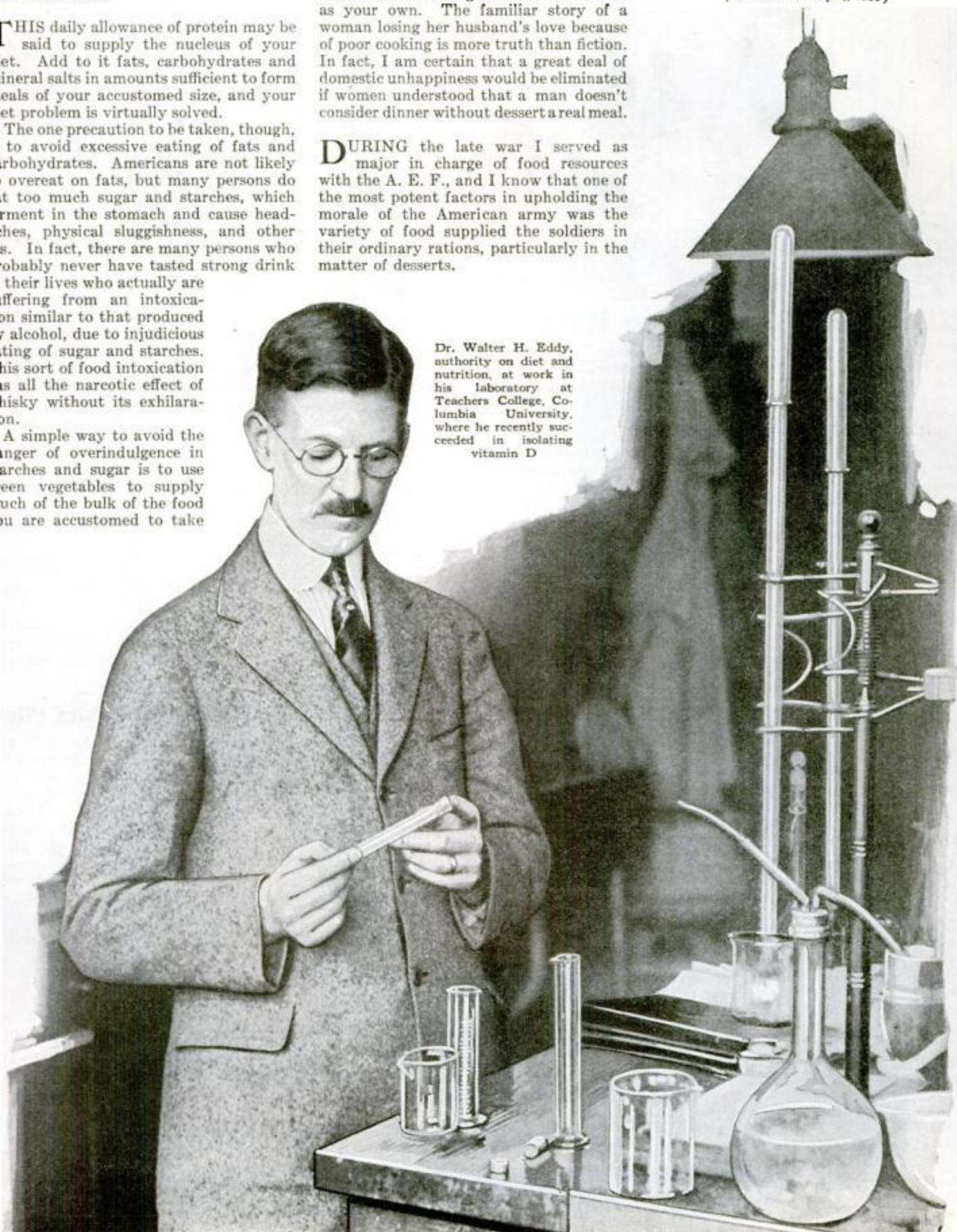
from potatoes, bread and similar starchy foods, and to substitute cooked fruit, simple puddings and ice cream for pies, pastry and other heavy desserts. Milk also should be taken regularly. It need not necessarily be drunk, but can be used in cooking.

Your food, of course, should be palatable, which is equivalent to saying that a dietitian's idea of a good meal is the same as your own. The familiar story of a woman losing her husband's love because of poor cooking is more truth than fiction. In fact, I am certain that a great deal of domestic unhappiness would be eliminated if women understood that a man doesn't consider dinner without dessert a real meal.

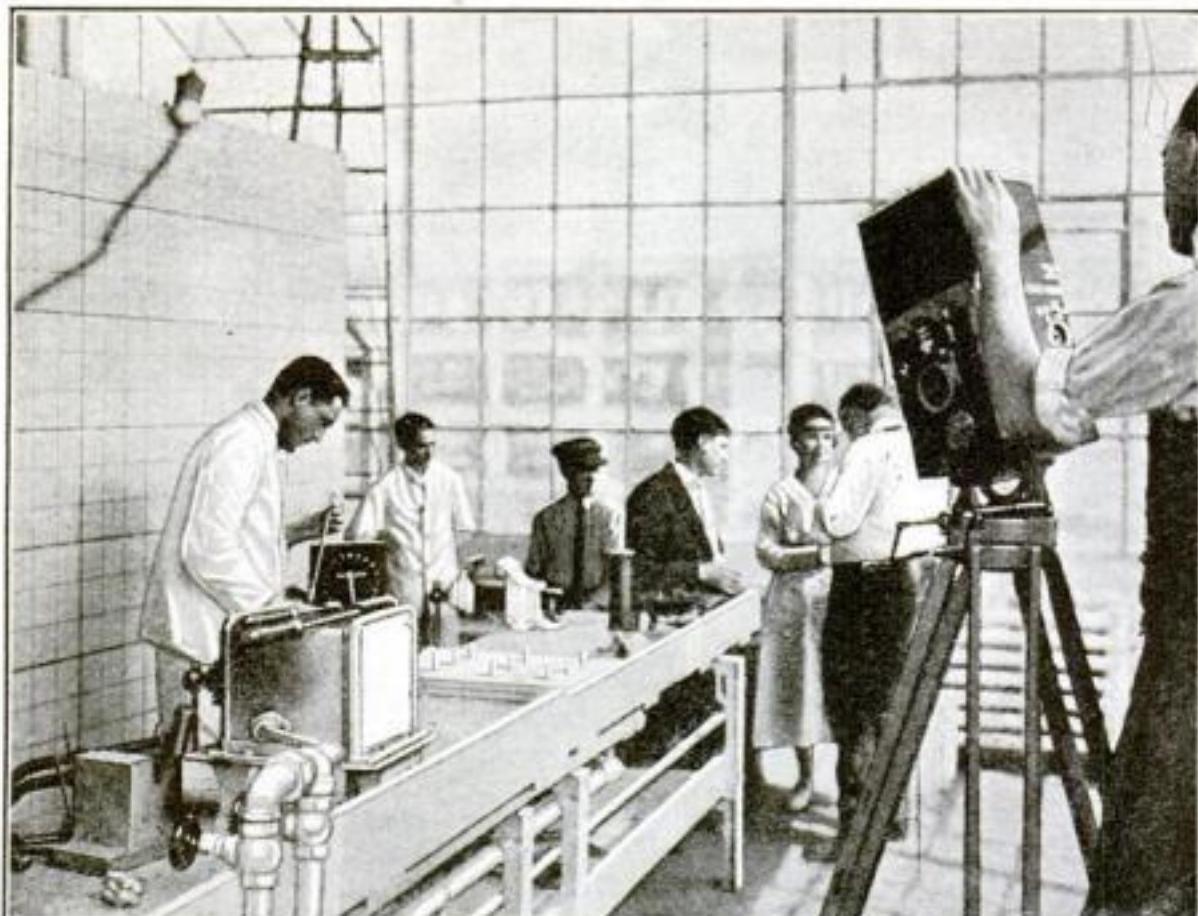
DURING the late war I served as major in charge of food resources with the A. E. F., and I know that one of the most potent factors in upholding the morale of the American army was the variety of food supplied the soldiers in their ordinary rations, particularly in the matter of desserts.

Another important point in the selection of the diet, and one which most persons are inclined to overlook, is the necessity of including food that must be chewed. The white meat of chicken and potatoes and white bread are palatable and digestible, but their fibers are not strong enough to supply the "roughage" which is necessary to intestinal digestion.

(Continued on page 115)



Dr. Walter H. Eddy, authority on diet and nutrition, at work in his laboratory at Teachers College, Columbia University, where he recently succeeded in isolating vitamin D



Efficiency of Workmen Revealed in Movies

THE superior technique of workmen who do more in less time than their fellows is being recorded on motion-picture film by efficiency engineers, using a plan invented by Frank B. Gilbreth.

Against a background marked off in squares so that it looks like a magnified piece of graph paper, the workman goes through a job in his best manner. Beside him is a clock with a single hand. This hand moves so rapidly around the dial that each of 16 film pictures taken in a

second shows it in a very different position.

The squares of the background, as they appear on the motion-picture film, serve as guides for exact measurement of distances covered by the larger movements of the workman, while the speeding hand of the clock reveals the exact time consumed by each operation that goes to make up the work. Thus waste movements and movements ordinarily made too slowly, are revealed.

Seven Tractors Move Huge Boiler Four Miles

S EVEN Ford tractors, five in front to do the pulling, and two behind to serve as brakes on down grades, hauled a 40-ton boiler recently from the Government Printing Bureau, in Washington, D. C., into Maryland.

The distance, four miles, was covered in 105 minutes.

Not even on the several rather sharp up and down grades was difficulty encountered, although the braking machines in the rear proved to be invaluable aids. The boiler rested on two large wheeled beds.



Handy New Tire Deflator Clamped to Valve Stem

THE handy automobile tire deflator illustrated above has been designed primarily to save time in doing tire repair work.

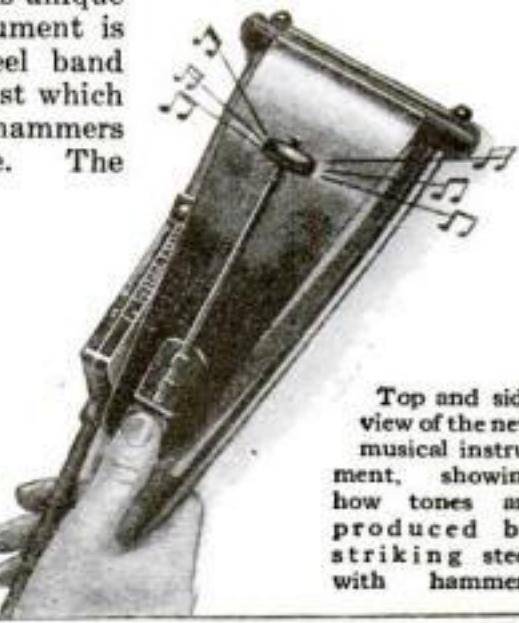
Usually to deflate a tire it is necessary to press the prong of the valve cap, or other similar object, against the valve pin until all the air has escaped. The new deflator, however, is clamped to the valve stem simply by a slight pressure of thumb and finger. In this position a small pin in the center exerts continuous pressure on the valve pin, compressing the spring. This leaves the hands of the worker free for other jobs, such as assembling repair tools, while the tire is being deflated.

SKIN from a patient's arm was used to make him new eyelids in an unusual operation recently performed at the Liverpool Royal Infirmary, England.

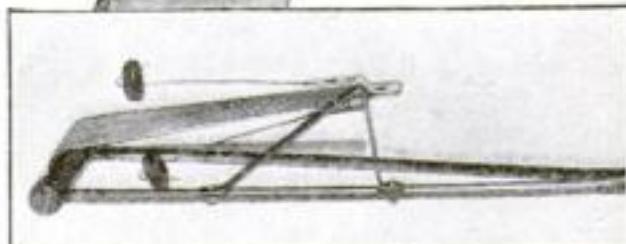
Flexed Steel Band Plays Music for Dancers

A NEW musical instrument, capable, it is said, of a surprising variety of "jazz" effects, is making its appearance in American dance halls. It can play solo or accompaniments, and is said by those who have heard it to be an effective addition to a trap drummer's repertoire.

This unique instrument is a steel band against which two hammers strike. The



Top and side view of the new musical instrument, showing how tones are produced by striking steel with hammers



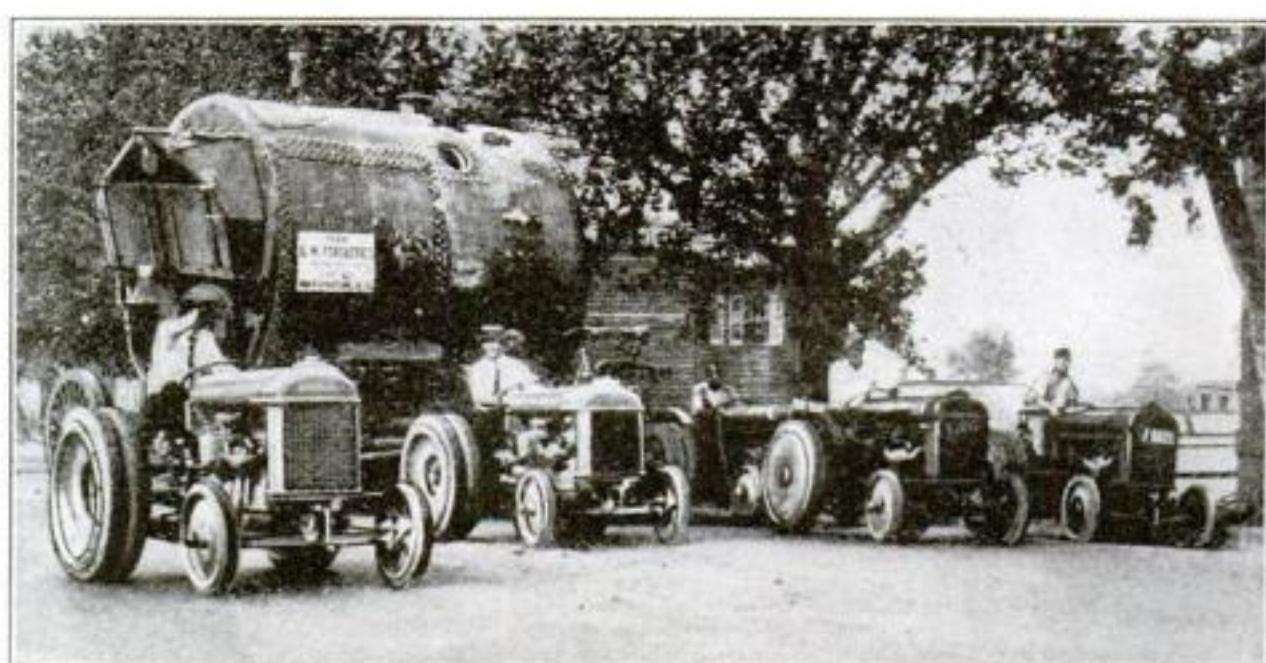
degree to which the band is flexed by the player's thumb determines the note played. The tone is described as a clear, flutelike, singing whistle, with a tremolo.

Loud or soft music can be played. A scale at one side guides the player.

The idea embodied is a modification of the vaudeville "musical saw." It is claimed, however, that a much greater range of tones is possible with the new instrument and that one can acquire fair proficiency quickly.

"Doorless Door" Bars Flies

TO TEST the efficiency of a newly invented "doorless door," designed to keep flies from entering meat and fish markets, 2000 house flies recently were imported from Dallas, Tex., to Boston, Mass. A screen of air from hidden electric fans above and below the door is used to bar the flies.



Five tractors hauling the 40-ton boiler. Two tractors in the rear acted as brakes

Camera "Gun" Is Mounted on Rifle Stock

REAL hunting without killing—usually fine photographs in place of dead game. This new brand of sport, requiring skill in marksmanship, is available now, it is said, with the perfection of an accurate camera gun made by mounting a standard aerial camera on a rifle stock.

The invention, originally developed for use by army observers, is rapidly becoming popular among amateur and professional photographers.

A turn of a crank at the side of the box winds the film and sets the shutter. A pull on a trigger makes the exposure.



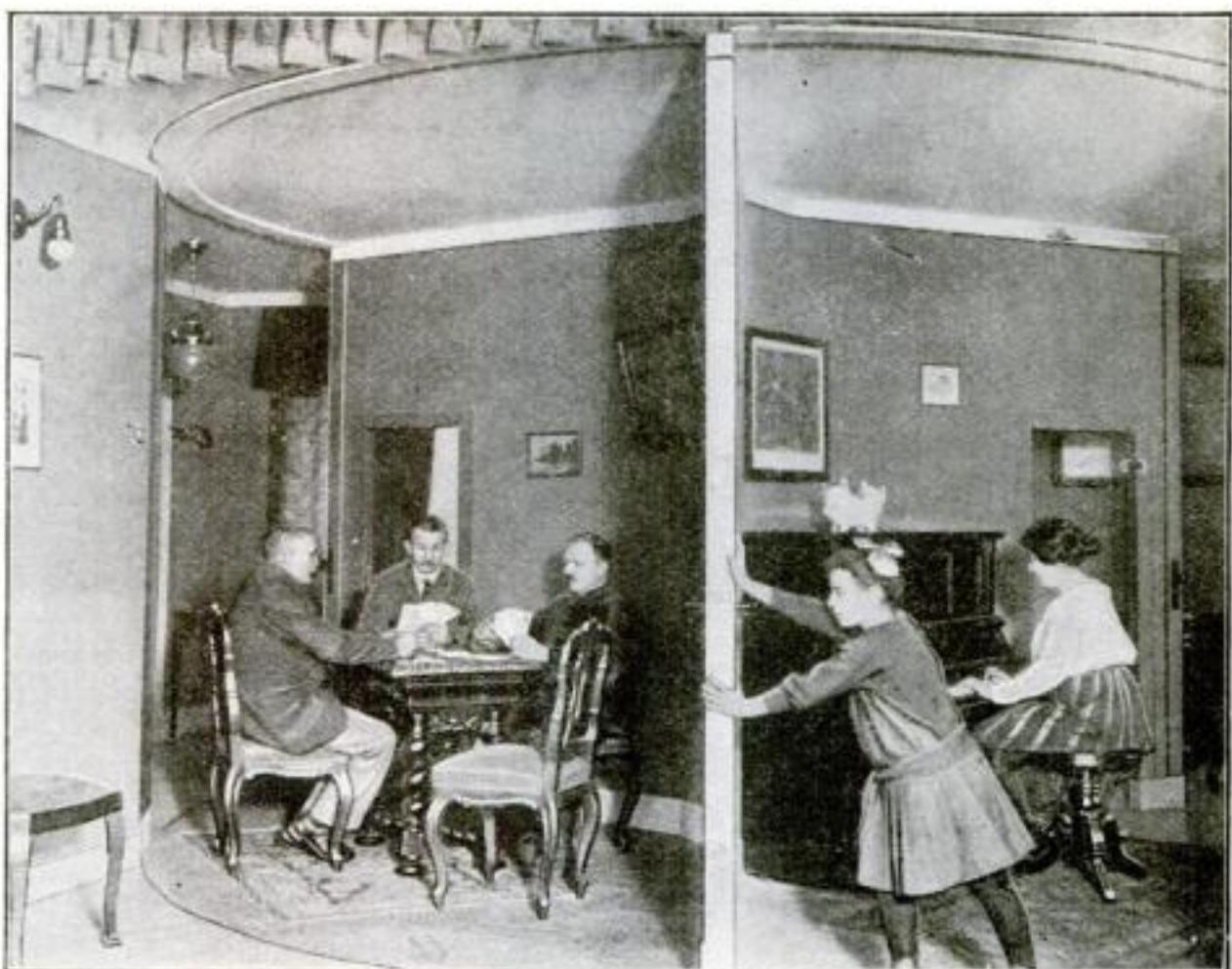
Traffic Signal Bends Over if Struck by Auto

MOUNTED on a ball-and-socket joint in the pavement, an ingenious new traffic signal gives at the instant of impact, allowing the car hitting it to pass safely over. It was invented by Frank Griswold, of Minneapolis, Minn., as the result of a collision with a stationary signal one stormy night more than four years ago, in which the inventor barely escaped death.

The signal is a slender pole, five feet six inches tall, anchored in its socket by six powerful coil springs, which right it when it has been overturned. Its lights continue to operate even when the pole is knocked flat.



Struck by car, the traffic signal bends and the car passes over it



"Turntable Home" Has Many Rooms in One

THE "turntable house," one of the world's newest ideas in home construction, has been originated by an architect in Berlin, Germany. Designed for the purpose of economizing in space, it is said to convert a single large room into several different rooms that are available for use as desired.

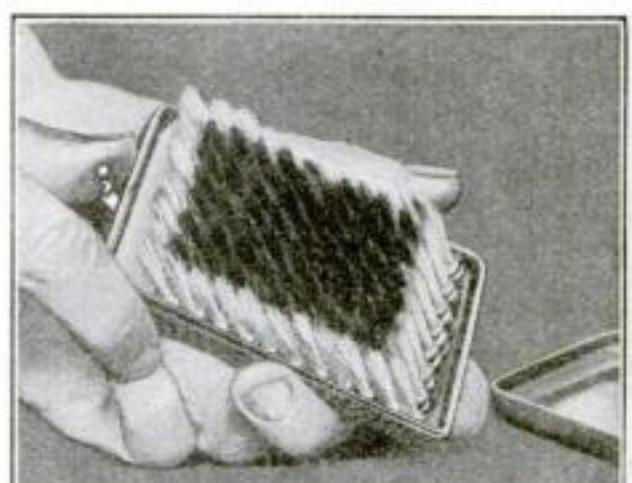
Each floor of the two-story house has one large room, at one side of which, con-

cealed by draperies, is a turntable divided in three sections. Each section, separated from the others by walls, is a room in itself. Thus, one section, furnished with a piano, may serve as a music room, another may be a card room, and the third a bedroom.

The photograph above shows the turntable, with two of its sections, being pushed around by a child.

When the Shoe Pinches

MANY people claim their corns warn them of weather change. But probably the corn merely is registering change in the shoe leather. This varies with the amount of moisture in the air. A two per cent change from normal either way is about all the average foot can stand without discomfort, according to a recent report of J. A. Wilson to the New York section of the American Chemical Society. He cited experiments to show that the amount of pinching varies with the kind of leather used.

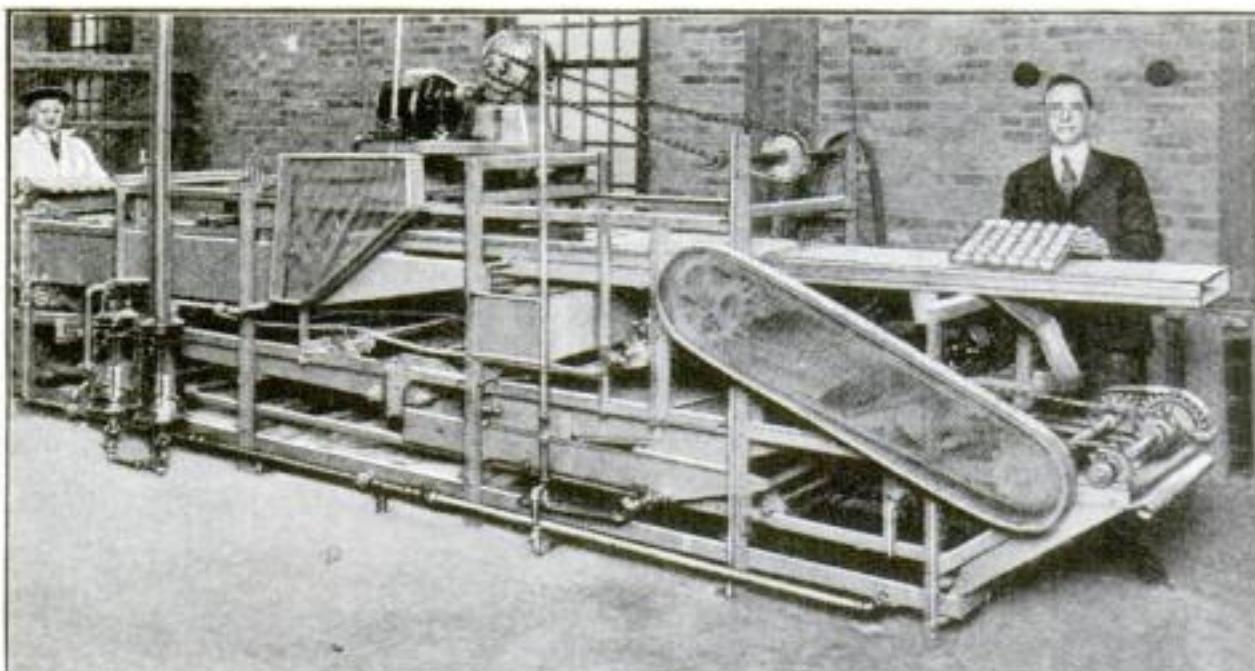


A Pocket Clothes Brush

MOVING a small lever causes the bristles of this pocket clothes-brush to lie flat, so that the entire brush can be carried in a case less than half an inch thick.

In the photograph above the lever is shown at the left and the thin metal cover of the case at the right.

Stature and Disease



Washes and Sterilizes 900 Dozen Eggs Hourly

EGGS are washed, rinsed, dried, sterilized, and dry-cleaned at the rate of 900 dozen an hour, by this huge machine with which seven girls are said to do as much work as 40 girls did formerly, and which is designed to reduce breakage 75 per cent.

The machine is fed at the left end with

trays, each containing 36 eggs. The upper portion washes, rinses, and dries them. Those to be sterilized are carried to the lower portion.

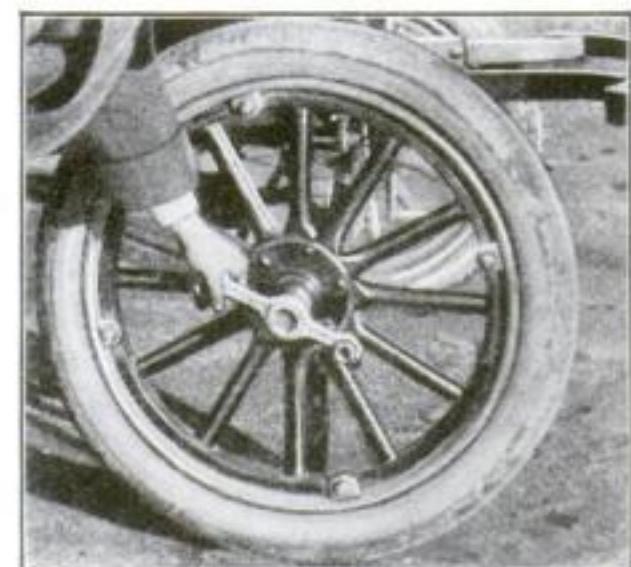
The sterilized eggs then are freed of gloss by reciprocating brushes.

The machine can be used as a cleaner alone, or as a sterilizer, as desired.

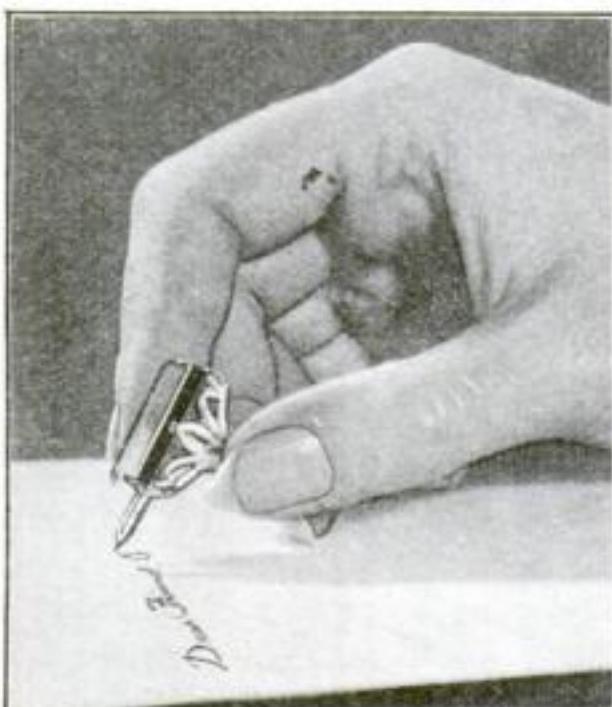
A Universal Socket Wrench for Ford Cars

PRACTICALLY every nut and bolt on a Ford car, it is claimed, can be gripped with the universal socket wrench pictured below.

Eleven different sizes of nut and bolt are provided for. Each size of socket is exact, a feature that prevents the rounding off of nuts.



Unscrewing hub cap with the wrench



Tiny Pencil Is Carried in Finger Ring

WOMEN often have no convenient way of carrying a pencil. Men, too, often find themselves without one, despite their numerous pockets. But every one can carry a ring, and a ring is not lost easily. This newly patented ring conceals a tiny refillable pencil.

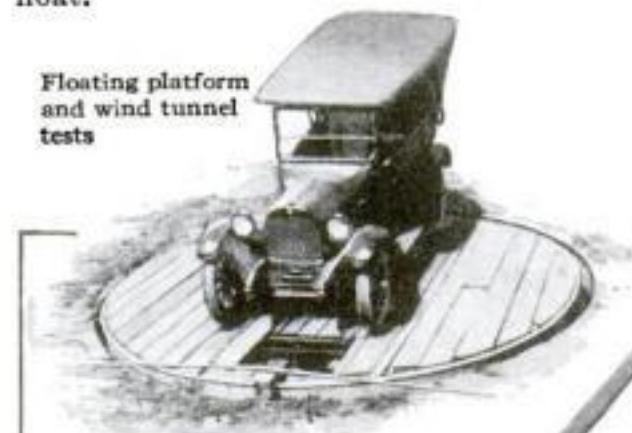
The pencil folds back under an oval or oblong of black onyx. A notch holds it firmly when in use. Turning a screw pushes the lead down as it is worn off. The stone is mounted in a silver setting on a silver ring.

Automobiles Tested for Wind Resistance

REVOLUTIONARY changes in the design of motor-car bodies are expected by some automotive engineers to result from experiments in progress at the Kansas State Agricultural College, to determine the best means of minimizing wind resistance.

Two unusual pieces of apparatus have been designed for the experiments—a floating platform and a wind tunnel. The platform is atop a hill, exposed to a clear sweep of wind, and is built on the top of a tank 16 feet in diameter that floats in a second tank partly filled with water. Four stay-ropes prevent side sway of the float.

Floating platform and wind tunnel tests

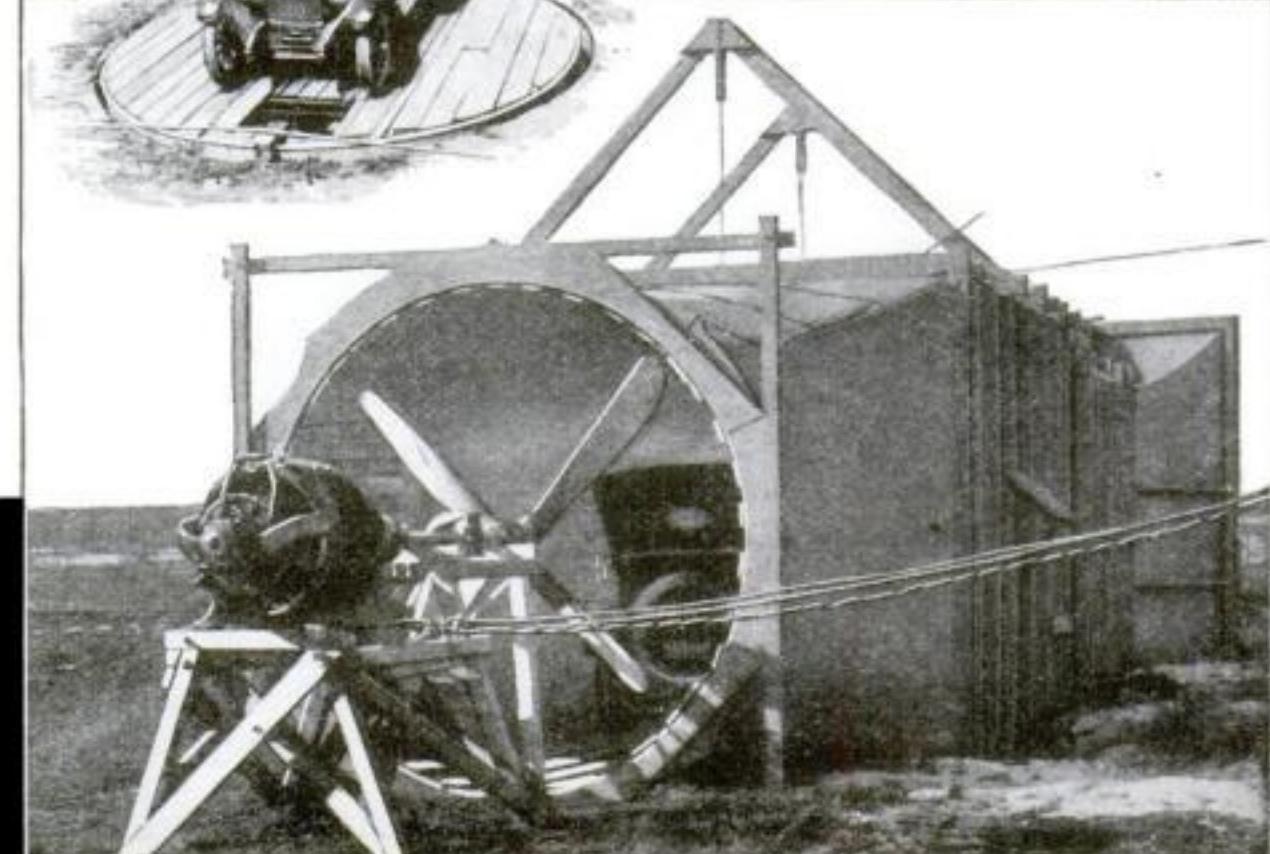


A car is driven on the platform, headed toward the wind. Instruments then measure precisely the drift of the float before the wind.

The wind tunnel is used to supplement the findings obtained by the floating platform. In it the wind, produced by an airplane propeller, is unchanging. The car being tested is driven into the tunnel on a platform. The portion of the tunnel occupied by the car is enlarged according to careful calculations, so that the car will not increase the air speed.

The push of the wind against the car is measured by determining the pull required to return the platform to the position it occupied originally.

A specially designed fan, capable of bearing 17 tons of centrifugal force upon each blade, is being built to replace the airplane propeller.

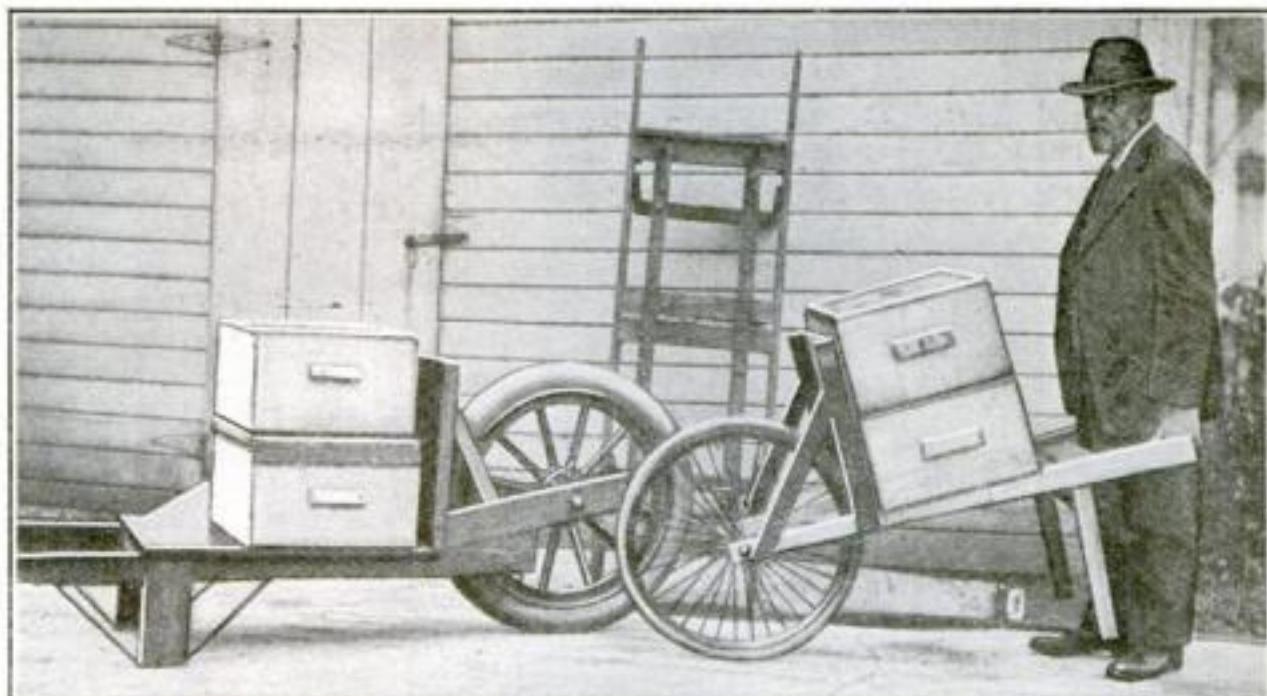


Tiny Spotlight Attached to Band Instrument

ATTACHING to the lyre of any band instrument, this device—an arm extending toward the mouthpiece and ending in a tiny spotlight—throws a strong light directly on the music score to be played.

A battery concealed in an attractive case behind the music rack feeds the light.

Any width of rack can be accommodated.



Builds Wheelbarrows with Pneumatic Tires

THESE odd, shock-absorbing wheelbarrows, equipped with pneumatic tires, were designed and built by N. E. France, a beekeeper of Plateville, Wis., for the purpose of transporting his bee-

hives without disturbing the honey-makers. He says the carriers can be used advantageously for other purposes, such as transporting eggs without danger of breakage, using either bicycle or auto tires.

Railroad Conquers High Peak of the Alps

INVALIDS and others who have not mountaineering legs now can ascend the Jungfrau (one of the most famed and beautiful peaks of the Swiss Alps) on a unique railroad that exemplifies remarkably the resourcefulness and ingenuity of modern engineering. The feat has taken nearly 30 years.

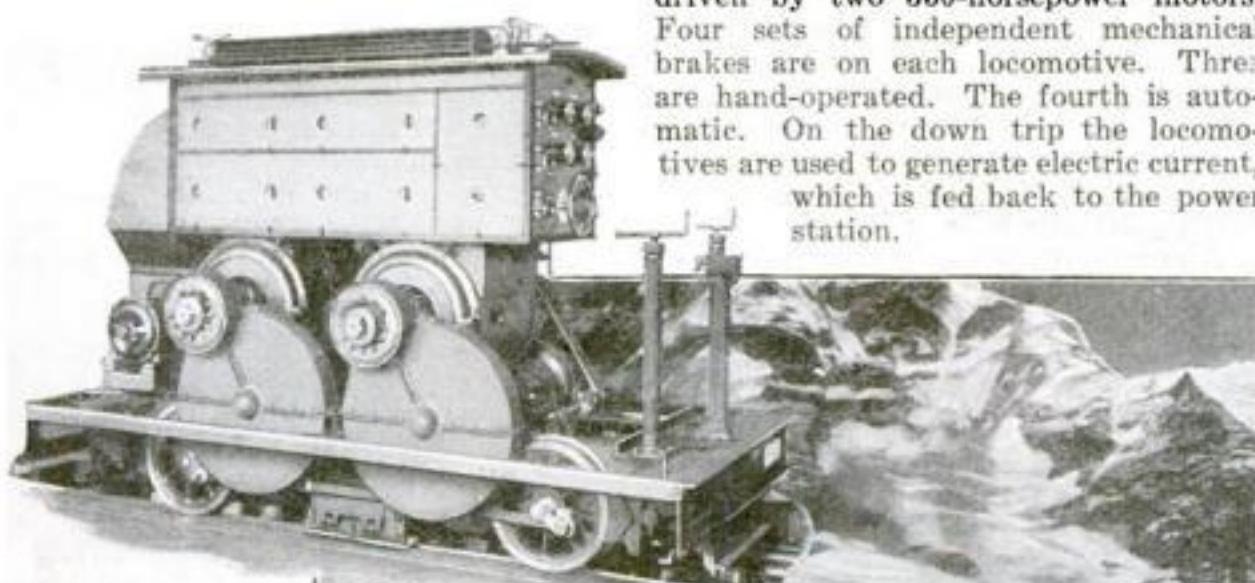
The road owes its existence to an ascension of the peak some years ago by a Swiss engineer, A. Guyer. So charmed was he by the tremendous panorama and the great chain of mountains, that on his return to his hotel he drew up a rough plan for the project, working until after midnight.

As most of the ascent lies within the

region of perpetual snow, that part of the road could not be built outside the mountain. The frequent avalanches and great depths of snow would have made it too dangerous. So the engineer arranged to bore a long spiral tunnel, keeping close to the sides affording the best views and breaking openings at intervals.

The entire length of the road is six miles, $4\frac{1}{2}$ of which are in the tunnel. A special spur gear track is used to insure safety, some of the grades running as high as 25 per cent. The highest station is 11,300 feet above sea level.

The 18-ton locomotives that haul the 35-ton trains up are among the most powerful ever built. They are electric, driven by two 350-horsepower motors. Four sets of independent mechanical brakes are on each locomotive. Three are hand-operated. The fourth is automatic. On the down trip the locomotives are used to generate electric current, which is fed back to the power station.



Above: One of the powerful engines that haul passengers up the steep side of the Jungfrau. The engine is stripped in the picture. At right: The mountain train entering the tunnel



Safety-Razor Blade Holders Permit Easy Stropping

SAFETY-RAZOR blades, single or double edged, can be stropped just like the veteran straight-edge razor with this new device. The blade fits in a holder that in turn is held tightly in a slot by the stropper.

Two holders, said to accommodate between them every kind of safety-razor blade, are provided. An ejector attachment is provided also. Blades can be inserted safely, quickly, and easily.

RECENT excavations in California brought to light two tools—a petrified bone awl about two inches long, and a rudely fashioned quartzite palm-ax.

Dr. William A. Bryan, director of the Los Angeles Museum of History, Science and Art, announces that the tools probably were used by the prehistoric men whose petrified skeletons were found near-by, believed to belong to the Pleistocene era, ending some 25,000 years ago.



Imitation Tobacco and Soap from Holly

LIQUID soap is thrown away every time a holly wreath goes to oblivion with the ashes and tin cans. That is, potential liquid soap is thrown away, for it can be made from holly leaves. So also can 11 other by-products, including animal food, medicinal tablets, confections, cigars, and champagne, the two last said to be deceptive imitations.

The production of this astonishing

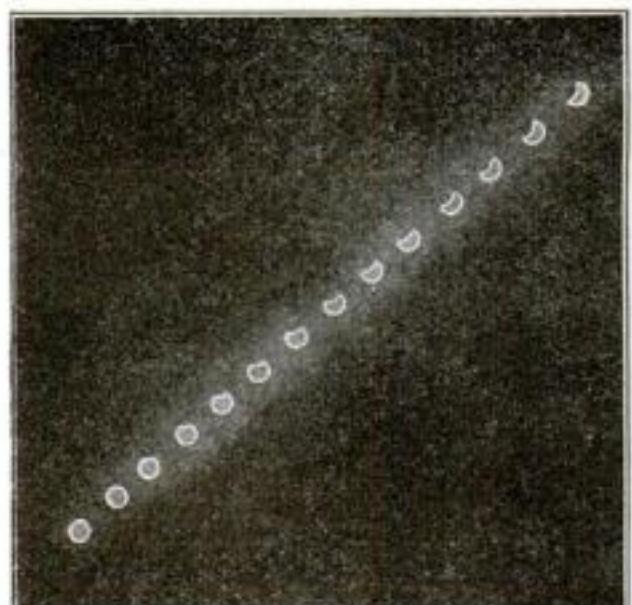
assortment from Christmas greenery is the result of 12 years' experimenting by Stephen M. Hoye, of New York, lawyer by occupation and chemist by avocation. Tirelessly and with huge zest, he has dedicated most of his leisure hours to this chemical necromancy.

His latest feat is imitation tobacco. The buckthorn is removed and the remainder cured, bleached, and flavored.

Fourteen Views of Eclipse Taken on One Plate

A REMARKABLE photograph, showing 14 different progressive views of the last solar eclipse, was taken by Victor H. Van Horn, a professional photographer of Three Rivers, Mich.

All the exposures were made on the one photographic plate. The first was made at 3.22.30 P.M. and the last at 4.27.30 P.M., a five-minute interval being allowed between each of the exposures. Every exposure was timed at 14/100 of a second.



Progressive view of a solar eclipse



Full-Size Microscope Folds into Pocket Length

AFOLDING pocket microscope, powerful enough to make blood counts and detect minute botanical structures, is now available for physicians, scientists, and students.

Although, extended, the instrument has a standard length tube, it folds into a case four inches long and three inches wide. It has a special invisible objective, with a focal length of six millimeters when used complete and 12 with the front element removed. Light is reflected by an inclinable mirror and a condenser.

Ice-Age Grasshoppers Found in Glacier

MILLIONS of grasshoppers that died during the Ice Age, some 500,000 years ago, are buried throughout a big glacier on the north flank of Mount Wise, near Yellowstone Park. The clean, glittering ice alternates with dark bands of frozen debris. In this debris, and on the glacier surface are frozen these myriads of mummified insects. They lie, for the most part, in layers.

Rangers of the park, particularly a girl ranger, Miss Margaret Lindsley, have been active in procuring specimens and investigating the extent of the find. They have found this hard and perilous work, it being necessary to cross a glacial lake that is set at the foot of the glacier by leaping from ice cake to ice cake.

A number of perfectly preserved speci-

mens have been found. These seem virtually the same as modern grasshoppers when placed side by side.

Scientists, attracted to the park by reports of the phenomenon, subscribe to the theory that the insects, coming in great swarms from their breeding grounds across the Bear Tooth Mountains, were driven to the ice by sudden storms and there frozen in, to remain in a state of almost perfect preservation for half a million years.

As a result of the wonderful find on the side of Mount Wise, the glacier has acquired a name of its own—it is now known as "Grasshopper Glacier." Already tourists are including it in their itinerary of a trip to Yellowstone, though the glacier lies outside the park proper.



Miss Shaw and Margaret Lindsley, the latter a ranger of Yellowstone Park, digging out bodies of 500,000-year-old grasshoppers from Mount Wise glacier

Below: One of the mummified grasshoppers found in the Mount Wise glacier by the millions. Scientists think they are probably relics of the Ice Age, an age that geologists place at approximately half a million years ago



This Finder Indicates Any Star Instantaneously

ANY important star or constellation can be located in a moment, it is said, with this new finder. The constellations are named on a dial and beside each name is a dot diagram of the group.

To locate a constellation, one places the finder on a level surface, the face to the north. The sliding pointer is adjusted to indicate the date, and the movable dial is adjusted to show the hour. The pointer with the open center is so that the name and of the constellation are seen through this

properly
adjusted,
this
finder
indicates
any star
desired

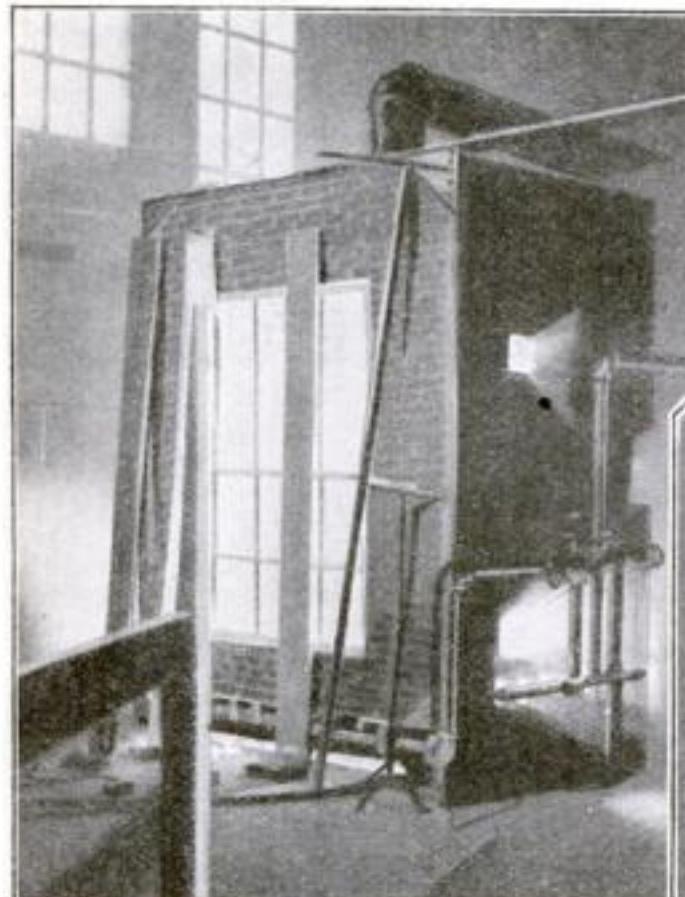
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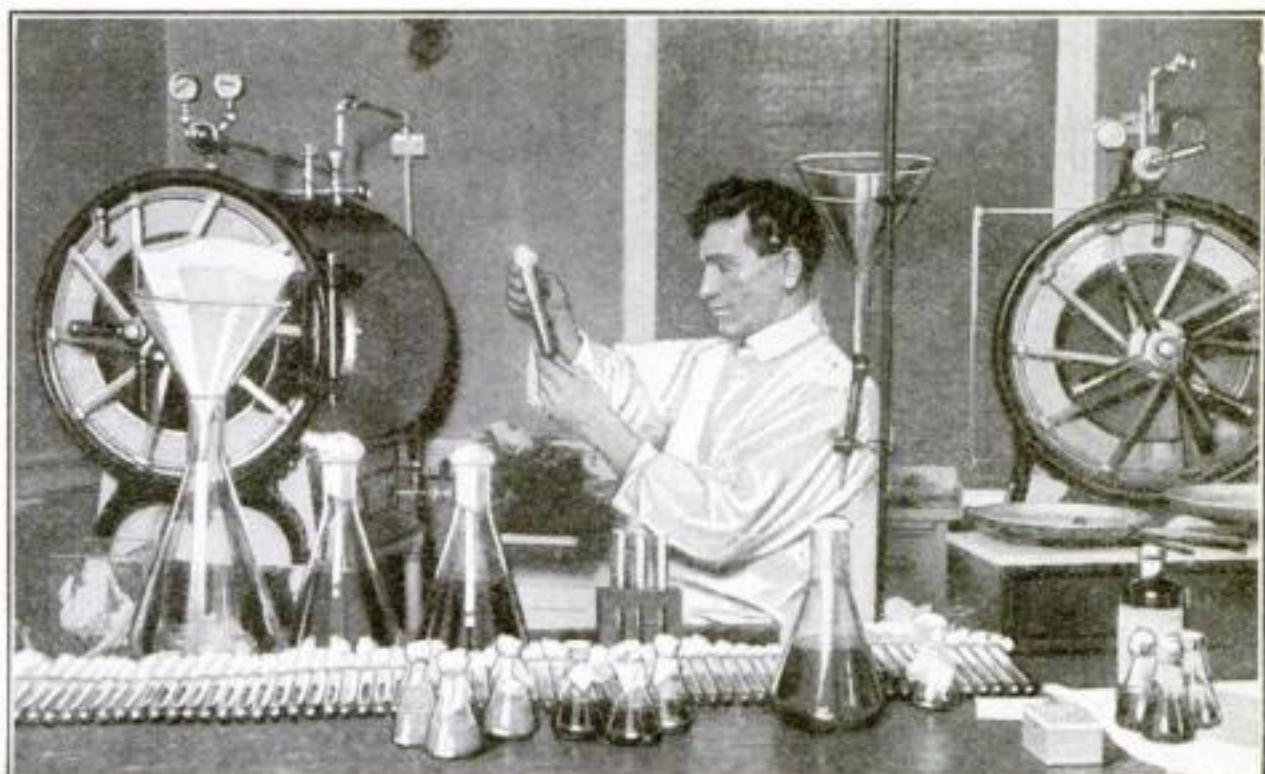
The arrow then is moved up or down until the number on the arc corresponds to the number within the pointer. The arrow now points to the constellation.

Directions list the stars in each constellation, showing how to find them by the dot diagrams on the dial.

Glass Windows Tested in Blazing Furnace



TO TEST the resistance of window glass to flames, the Underwriters' Laboratories use a gas furnace in which a temperature of 1800° F. is maintained for half an hour. The wire glass windows are set in a frame in one of the walls of the brick furnace, as shown in the picture at the right.



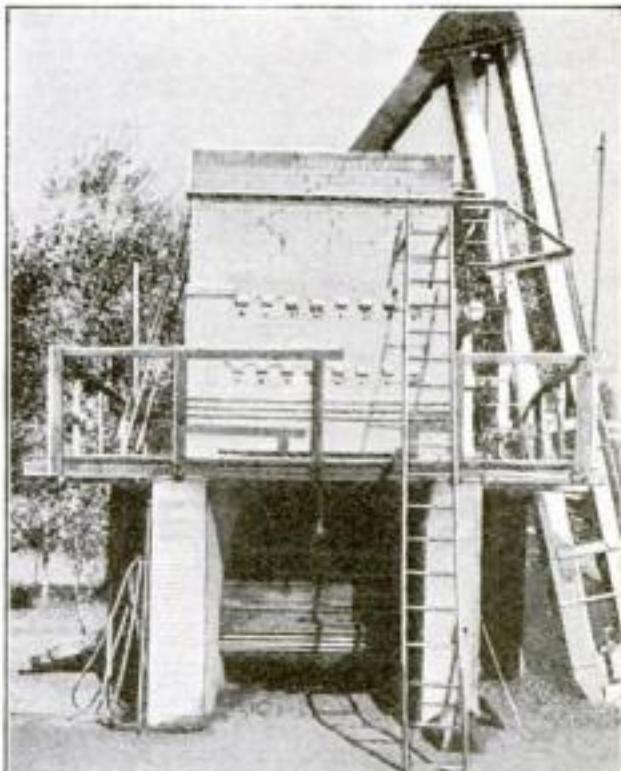
Bacteria Earn Board in Health Service

BACTERIA have their own boarding-house, run by the Public Health Service, at Washington, D. C. Although the menu always is soup, and nothing more, it is by no means the watery soup that is supposed to be characteristic of boarding-houses. Steak, eggs, potatoes, gelatin, and milk are among its ingredients, and the 60,000,000,000,000 small boarders are said to grow plump rapidly on it.

Tables being considered not feasible, the bacteria dine in tubes, in intimate little groups of 10,000,000,000. This makes it necessary for L. J. Bender, their chef, shown inspecting one of these groups, to supply soup to 6000 tubes daily.

The "boarders" earn their keep by

serving as research assistants in the Public Health Service's laboratories.



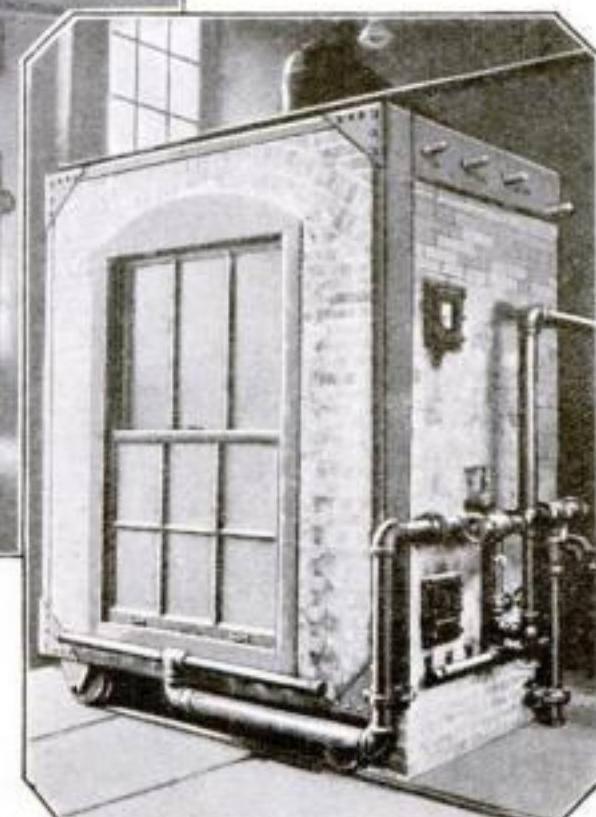
New Lignite Process May Lower Coal Bills

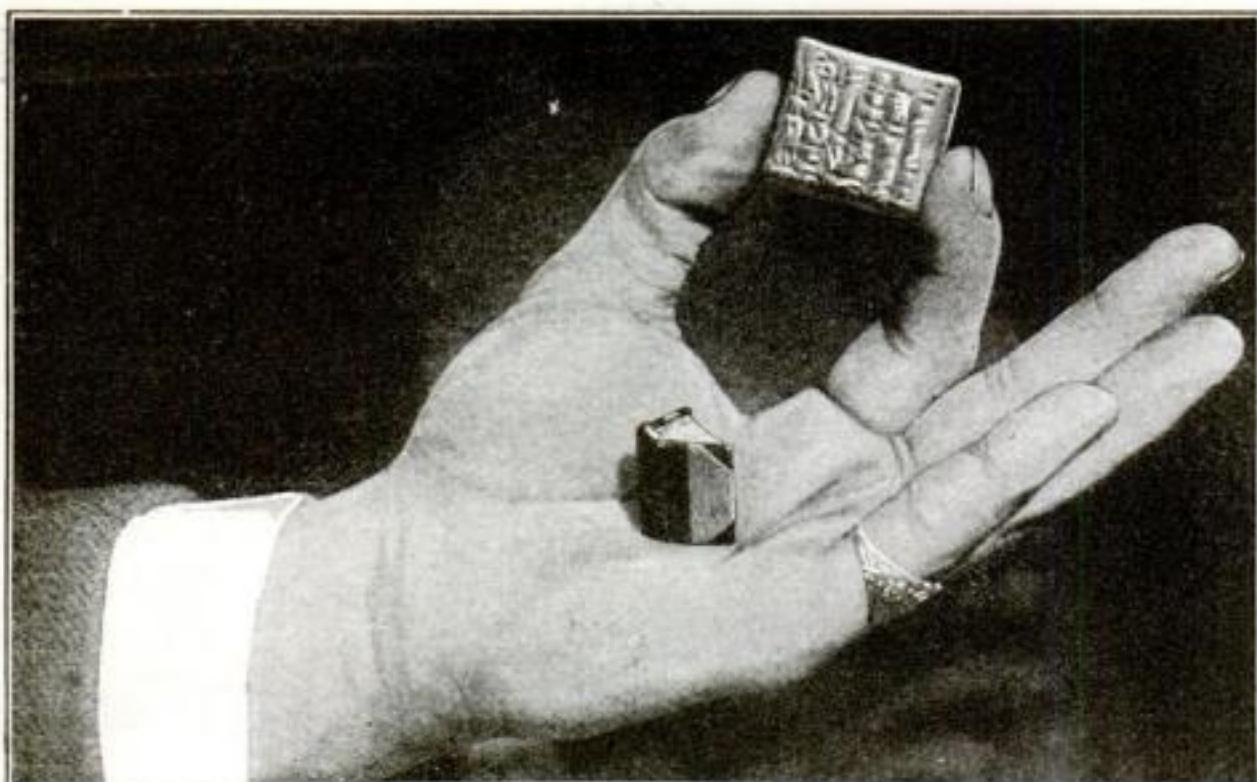
LIGNITE is transformed into a fuel claimed to possess the heating qualities of anthracite coal by this new oven, perfected by the United States Bureau of Mines.

Lignite—primeval wood prevented from becoming coal by the excess of water in the earth surrounding it—underlies great areas of the Northwest. The Bureau estimates the cost of producing it at \$8.17 a ton.

The oven is essentially a vertical shaft with a top opening through which the raw lignite is supplied. Carbonization is effected by maintaining a combustion zone in the middle of the shaft and passing the lignite through it slowly enough to maintain a state of bare combustion. This is accomplished by supplying air under slight pressure. Varying air pressure and the rate at which the carbonized fuel is discharged regulate the degree of carbonization.

The carbonized lignite is in the form of char, which usually must be briquetted. A ton of lignite yields 42 per cent char.





The World's Oldest and Smallest Books

THESE two books—one said to be the oldest, the other the smallest in the world—are on display at the University Library in Philadelphia, Pa. The oldest book—about an inch and a half square—is a record of commerce and barter inscribed on stone during the Ur dynasty of

the Babylonian kings, more than 5000 years ago. It is shown between the fingers of the hand above.

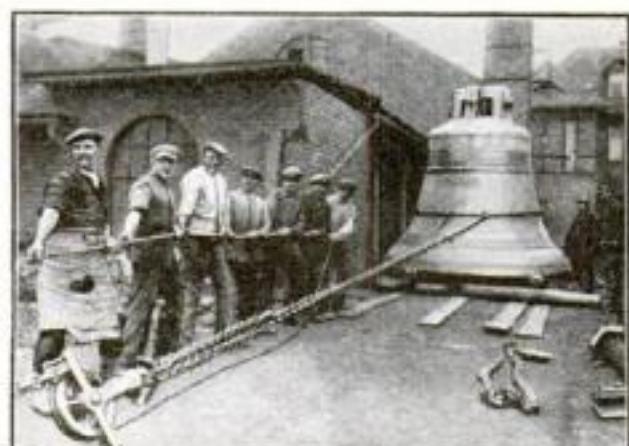
The smallest volume, made only a few years ago and containing several hundred pages, rests in the hollow of the hand as pictured above.

World's Largest Bell for Cologne Cathedral

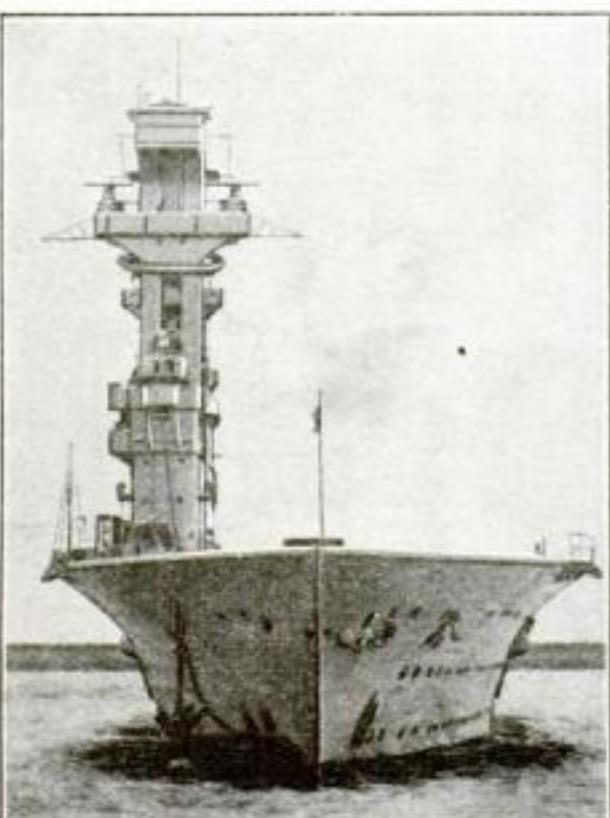
THE largest bell in the world, a magnificent modern example of the bell-maker's exacting and historic craft, was completed recently for the tower of the famous Cologne cathedral, in Cologne, Germany. The ornamentation of the great bell, although simple, is said to have been wrought with rare artistry.

Its ancient predecessor in the old steeple was removed during the Great War and melted for use as metal for munitions.

In the photograph below workmen are shown moving the bell on rollers by means of block and tackle.



Moving the huge bell on rollers



One-Sided Ship a Landing Field for Aircraft

THE something that seems to be missing from this ship never was there. The vessel is the British naval aircraft carrier, *Hermes*, and the flat, open space is a landing-deck for the seaplanes she mothers.

The superstructure has been compacted into a five-story starboard tower. The craft is ballasted heavily to port to compensate for the weight of the tower. Exhaust from her engines escapes through horizontal funnels at the stern.

The *Hermes* is said to be the finest craft of her type in the world.

MOLES may be controlled by placing teaspoonful quantities of concentrated lye in their runways at 25- and 50-foot intervals, recent experiments indicate.

Shopper's Pencil and Vanity Case Combined

DESIGNED especially for the woman shopper, an unusual combination of pencil, powder puff, and rouge stick is handy either for jotting down shopping notes or for renewing the complexion.

While the pencil is small enough to be carried in a compartment of a small handbag, the upper part of the holder serves as the vanity case. Powder puff and rouge are made available

by removing a cap, which contains a day's supply of powder. In the lower part of the holder is another compartment with an extra supply of leads for the pencil.



The pencil with cap removed, showing powder puff and rouge

"Auto Grasshopper" Survives Hard Bumps

AN EMBANKMENT at a dangerous turn in the road probably would hold no terrors for a newly invented automotive "grasshopper" shown below in mid-air during a six-foot jump.

The car, the ingenious creation of a French engineer, has extraordinarily powerful springs, so that even a hard fall cannot smash it if it lands upright, the maker



claims. Also, it is said to be fire-proof, so that a bad crash could not set it ablaze.

Although the car seems to lack an engine, it has one, just in front of the rear wheels.

It is the inventor himself who is shown in the picture below handling his acrobatic car.

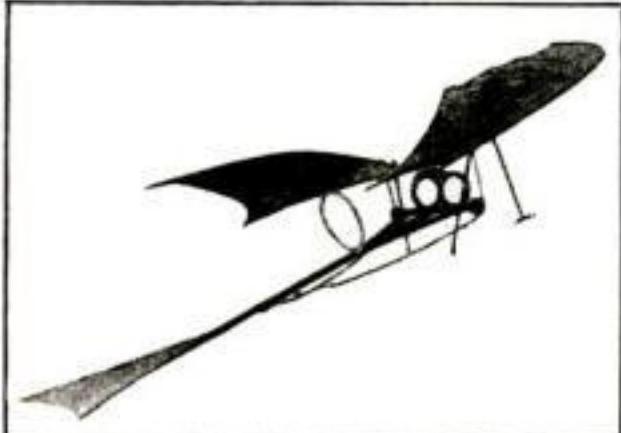
Making a six-foot jump from an embankment in the new shock-proof automobile



Model of a da Vinci Plane Built from His Plans

ALTHOUGH for centuries it has been known that Leonardo da Vinci, brilliant medieval engineer and renowned painter of the "Mona Lisa," had made extensive researches in aeronautics, the recent discovery in an Italian monastery of parchment records of many of his researches was the modern world's first concrete knowledge of them.

Below is pictured a model from one of his sketches, built recently at the National Museum of History, at Washington, D. C.



Model built from da Vinci sketch

It is an impressive witness to the creative foresight of the great artist.

Da Vinci approached the problem of flight by analyzing the equipment of birds. This model is designed to be flown by the flapping of the wings, operated by a pilot lying prone on the frame.

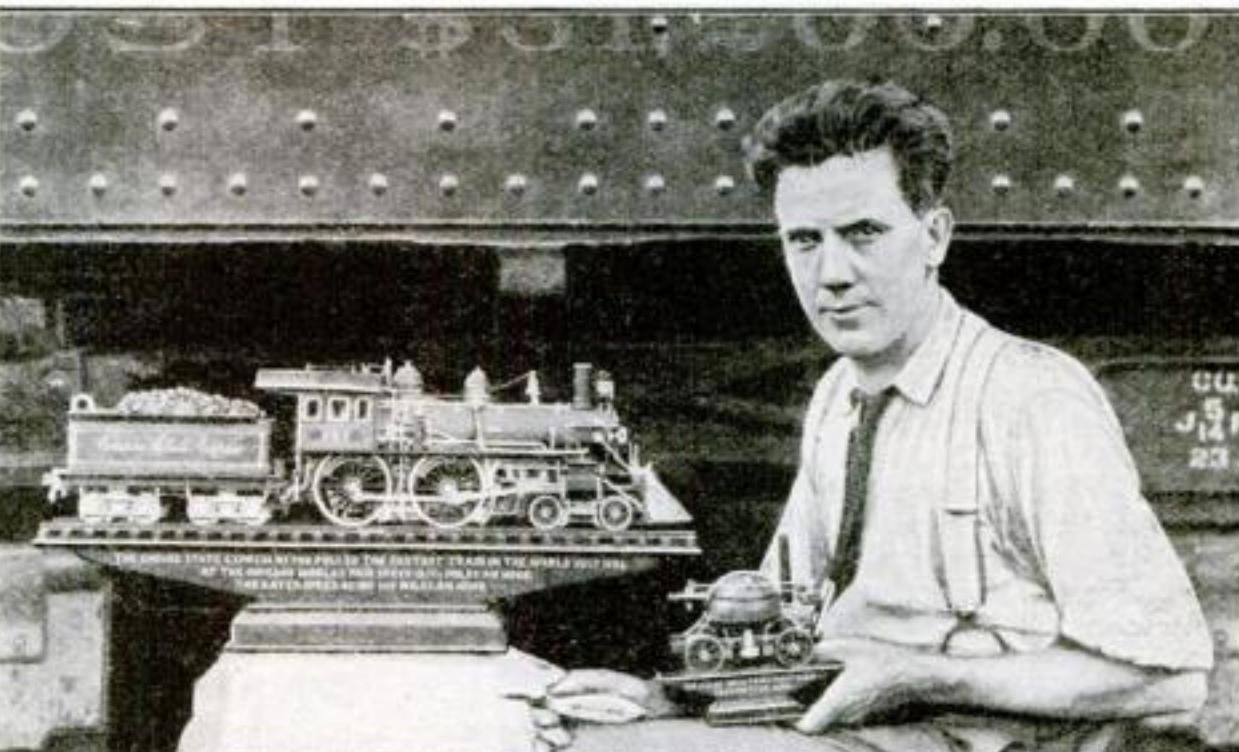
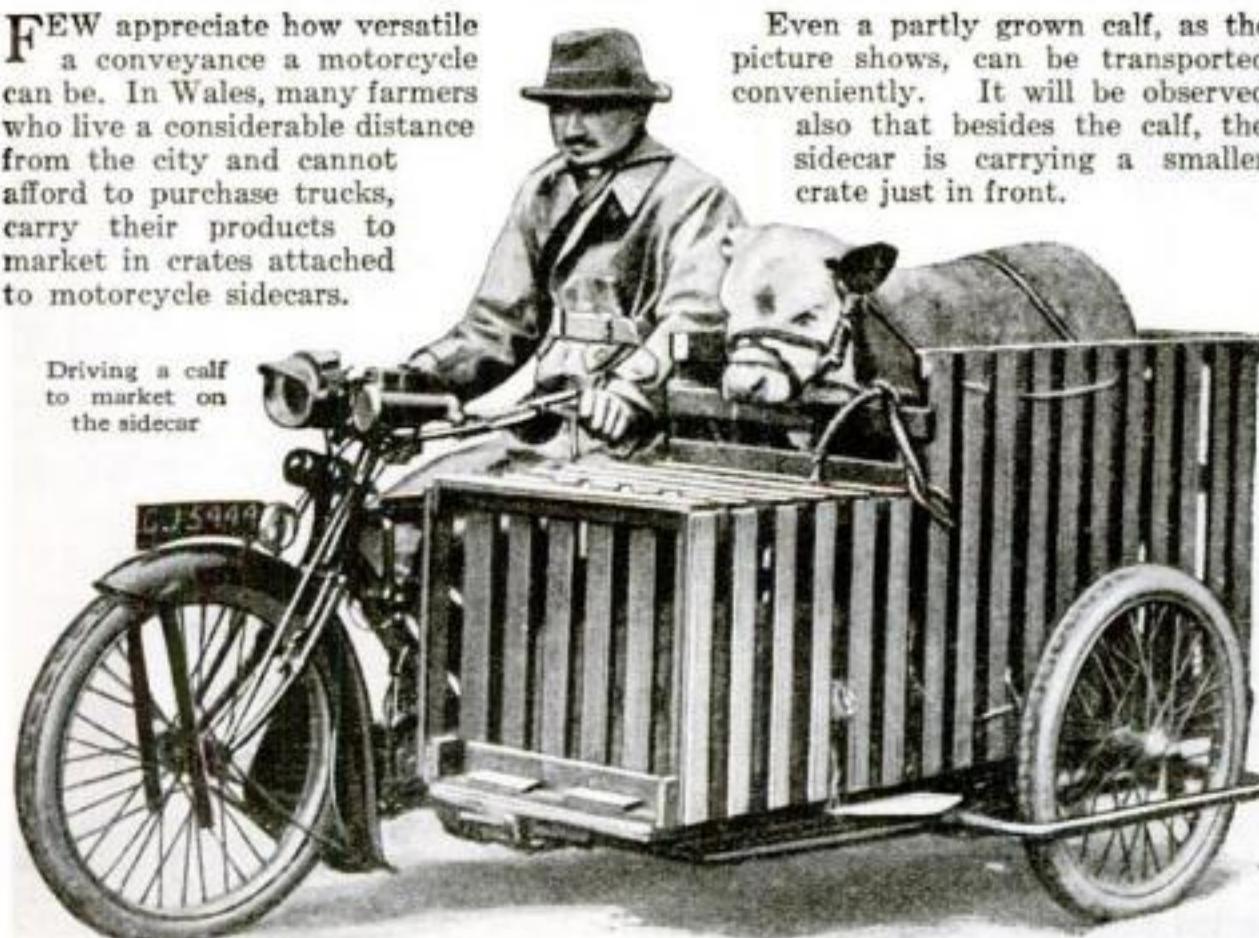
Healthiest Year on Record

THE last year has been the healthiest year on record in the United States, according to statistics of the U. S. Public Health Service and leading insurance companies. Tuberculosis, heart disease, apoplexy, Bright's disease, influenza, pneumonia, and diabetes all showed a substantial decrease from the year before.

Sidecars Carry Farm Products to Market

FEW appreciate how versatile a conveyance a motorcycle can be. In Wales, many farmers who live a considerable distance from the city and cannot afford to purchase trucks, carry their products to market in crates attached to motorcycle sidecars.

Driving a calf to market on the sidecar



Carves Wood Models of Famous Locomotives

WITH his knife, Ernest Warther, of Dover, Ohio, for years has been recording the history of locomotive building in wood. His astonishingly detailed carved models have been inspected by thousands, including admiring fellow carvers, at exhibitions. Even to the fittings of the pipes that run along the body, and to the smallest detail of the

couplings, his wooden miniatures are faithful reproductions.

His collection now includes models of most of the famous locomotives that have marked epochs in the development of steam transportation. These range from Sir Isaac Newton's tiny locomotive to the famous "999," holder of the world's locomotive speed record, 121.3 miles an hour.

How to Flavor Your Coffee

THERE is a best way of doing everything—even of putting sugar and cream in your coffee. In fact, to put sugar and cream in your coffee is quite wrong, according to the dairy experts of the U. S. Department of Agriculture. The correct procedure, they say, is to put cream in the cup, then the coffee, and add the sugar last of all. This will prevent the cream from "feathering" should it be slightly sour. Coffee poured on cream and sugar in a cup is almost certain to result in the cream's curdling.



Radio through 120 Feet of Solid Rock

RADIO waves can leap through 120 feet of solid rock about as swiftly as through free air. This was demonstrated recently at Rocky River, Ohio, when a receiving set placed that distance underground in a mine shaft picked up concerts from local and distant stations.

The set was used with a highly directional loop. Because the tunnel at no point was higher than 5½ feet and averaged four feet in width, the sides and roof exerted a marked ground capacity. This was overcome by swinging the loop parallel with the mine shaft, proving that the radio waves heard were penetrating the rock, not entering the mouth of the tunnel.

A loudspeaker was used. Local stations came in very loud, and many distant stations were heard faintly.

New Motor Fuel to Silence Knocks

BY THE middle of this summer you will be able to purchase at approximately 30,000 filling stations in various parts of the country, a fluid that will double the efficiency of your automobile, eliminate the troublesome motor knock, and give you 100 per cent greater mileage in addition, according to engineers of the General Motors Research Corporation, inventors of the product. This liquid will be mixed in small quantities with your regular gasoline, at the additional cost of three cents a gallon over the current price of gasoline, it is announced by authorities on fuel.

The name of this new product is "ethyl gas," a combination of commercial gasoline and tetra-ethyl-lead. It is the fruit of seven years of research in which chemical engineers sought a fluid that would increase the efficiency of the gasoline motor.

For a long time it has been common knowledge among experts that only five per cent of the inherent power of the fuel used in internal combustion engines ordinarily is utilized by the motor; that the other 95 per cent is wasted through the exhaust pipes; blown into the air without doing a bit of useful work. To reduce this waste, designers have known that it is necessary merely to increase the power of the motor by increasing the compression, but they also have known that when this is raised beyond certain well defined limits, the engine begins to knock.

RECONIZING that the standardization of fuel composition was one of the necessary achievements toward realizing the perfect motor, the engineers of the General Motors Research Corporation at Dayton, Ohio, set out to discover the cause and prevention of the gas knock.

After careful investigation they learned that the knock is caused not by pre-ignition, as was generally supposed, but by the creation of a high velocity gas wave in the combustion chamber, due to certain imperfections in present-day gasoline. This wave, striking against the piston or cylinder head, causes the knock, which actually is the result of detonation.

Searching for a remedy, they added various chemicals, singly and in combination, to commercial gasoline in an effort to find a fuel that would eliminate the high velocity gas wave. Approximately 2500 substances were tried and

By Robert E. Martin

discarded because of excessive expense, corrosion in the motor, offensive odor, or other drawbacks. Finally it was discovered that tetra-ethyl-lead would produce the desired results. The solution had been found!

But alas, a pound of the precious fluid cost \$585, and the amount necessary to ethylize six gallons of gasoline—which cost a few cents a gallon—would cost six dollars! Three years more of experimenting and the test-

The basic supply of ethyl fluid is the Du Pont Chemical Company at Wilmington, Delaware. The product is shipped to Dayton, where it is blended in a special department of the General Motors Corporation and prepared for shipment in sealed cans. These are standard sized containers that hold five liters, sufficient to ethylize 1000 gallons of gasoline.

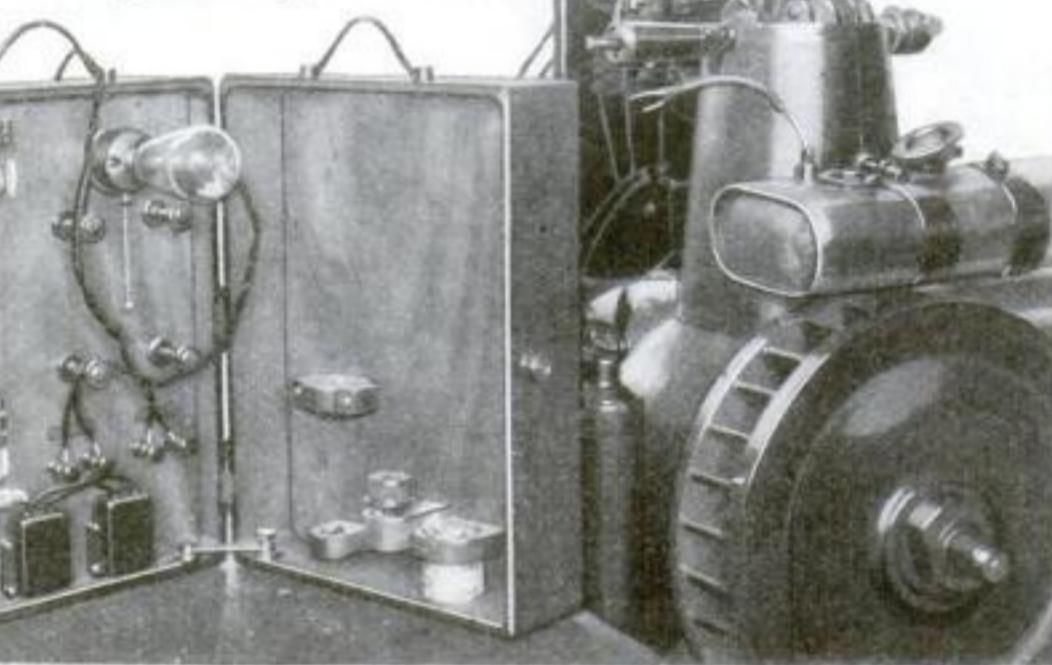
FOR dispensing, the ethyl is poured into a specially designed vending mechanism attached to filling station apparatus, allowing the pump to be used for standard gasoline or ethyl gas. One revolution of the little crank on the side of the ethyl container liberates enough fluid to treat a gallon of gasoline.

Ethyl does not produce high test gasoline from a medium test product, nor does it add power to the gasoline proper. It simply changes the conditions under which fuel is consumed in the motor.

Demonstrations are reported to have proved conclusively the beneficial effect of the addition of tetra-ethyl-lead to gasoline. A single-cylinder engine running at about 1000 revolutions a minute first was used in the tests. It ran smoothly on commercial gasoline, carrying about 80 pounds compression to the square inch. The addition of kerosene to the tank developed a severe knock and the amperage shown on the dial dropped from 25 to 17.5. The addition of a small quantity of ethyl fluid at once removed the knock and brought back the amperage to its original figure of 25.

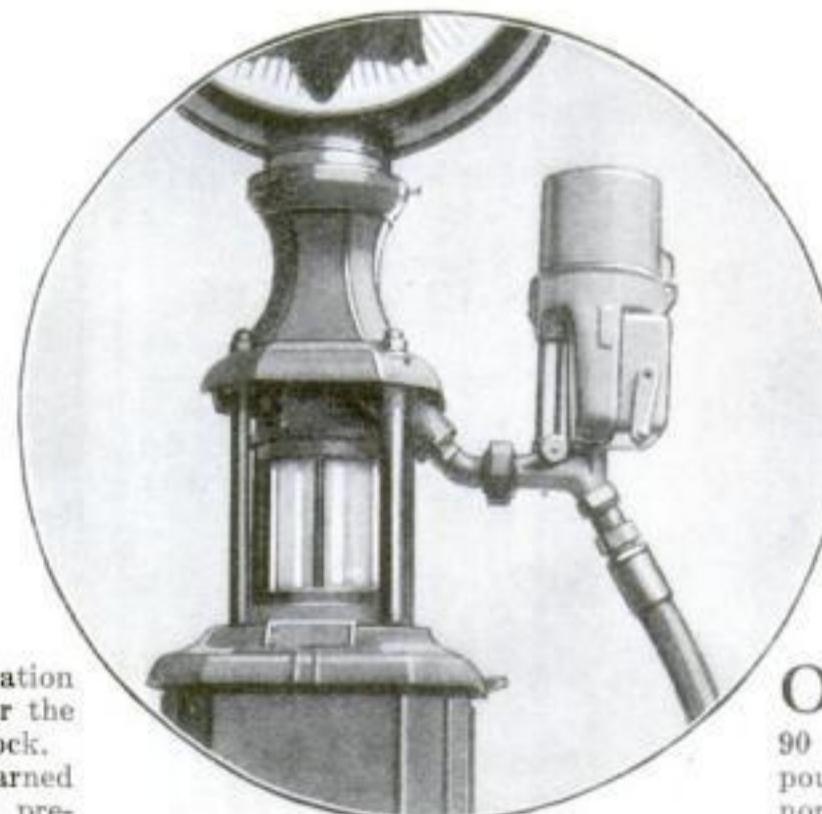
ON SEVERAL standard automobiles the normal compression of from 60 to 90 pounds was raised as high as 160 pounds to the square inch, which, under normal conditions, would produce violent knocking. With ethyl gas these cars climbed steep grades in high speed at less than 10 miles an hour without even a trace of a knock and without the slightest injury to the engine.

What will this discovery mean to the motorist, to you and your neighbor? If general usage substantiates preliminary demonstrations, it will mean that the efficiency of your present motor will be doubled; the power that may be obtained from gasoline resources will be doubled, the life of your car engine will be lengthened and the operating cost will be cut.



One of the engines with electrical apparatus used to test the new ethyl gas and other fuel combinations. On top of the engine cylinder

is an apparatus connected with an electric light, shown in the case at the left, that glows with every explosion of the fuel



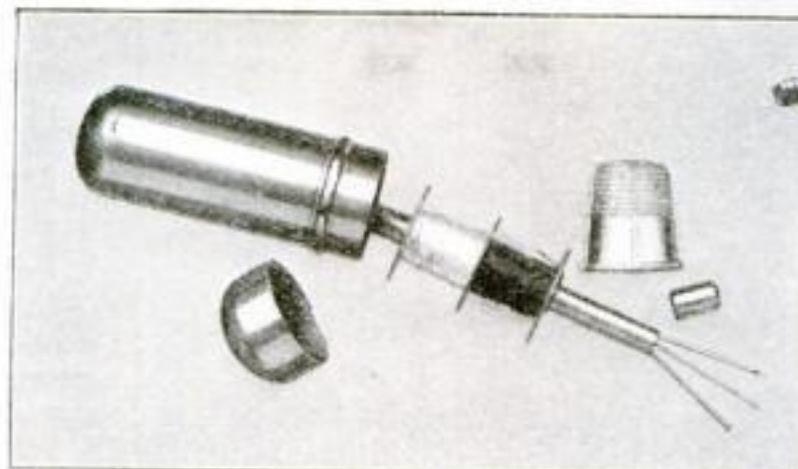
This attachment to the filling station apparatus mixes ethyl fluid with gasoline as it is dispensed. The device has a crank, each turn of which releases just enough of the new knockless fuel to treat a gallon of gasoline

ing of additional thousands of schemes finally produced a means of producing tetra-ethyl-lead commercially for $12\frac{1}{2}$ cents an ounce—an amount sufficient to ethylize six gallons of gasoline. The remaining problem now was that of marketing the new fuel, which was solved in this way:

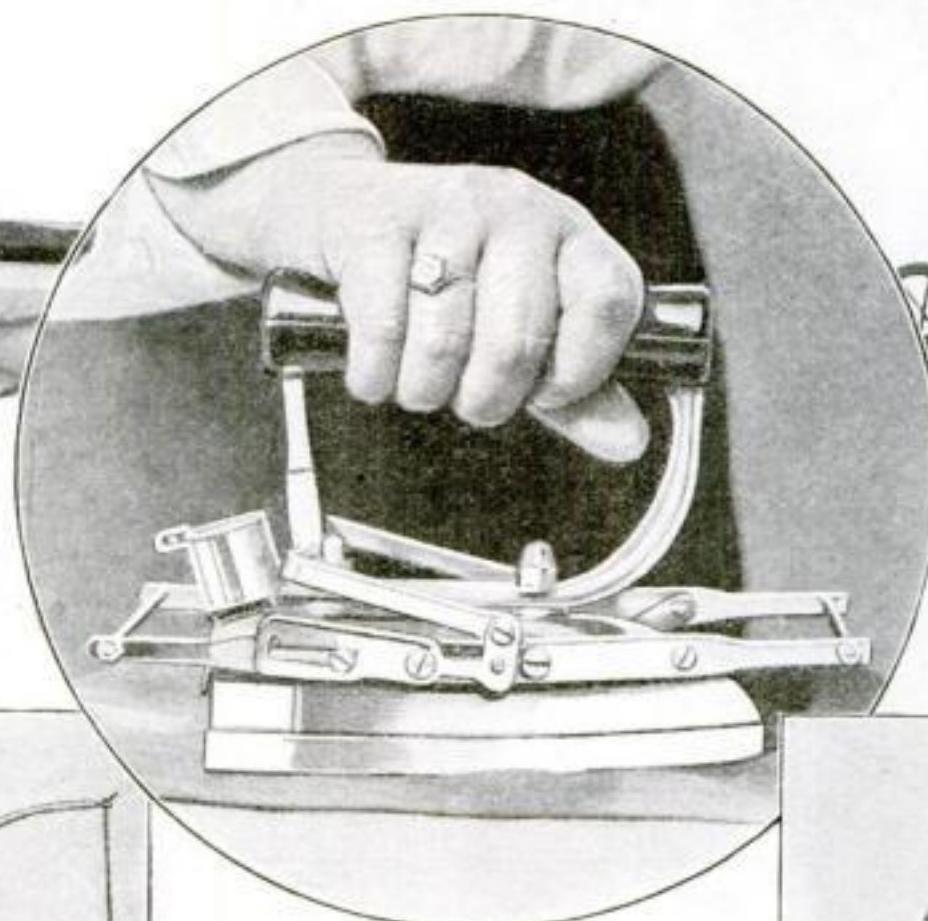
Better Tools for the Housewife



Worn and shiny garments can be renewed, it is said, with this rotary device containing thousands of tiny needles with microscopic hooks that bite into the fabric and pull up new nap



This compact sewing kit, $2\frac{1}{4}$ inches long, contains thimble, pins, a variety of needles, and two bobbins for thread. The metal case is said to be rustproof

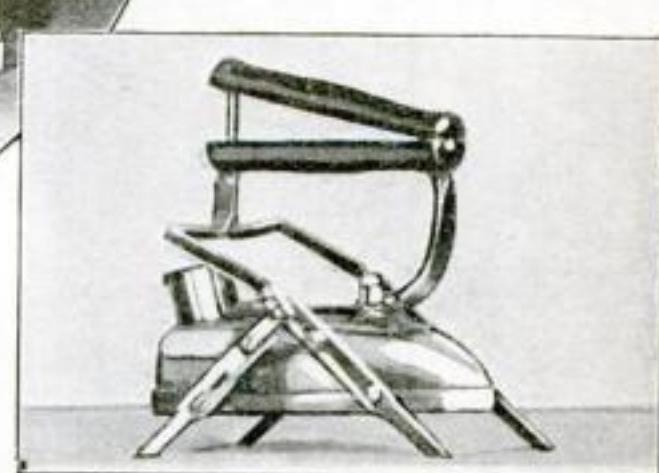


A newly invented high chair becomes a baby carriage when folded down, the tray being removable. The carriage is equipped with a safety brake



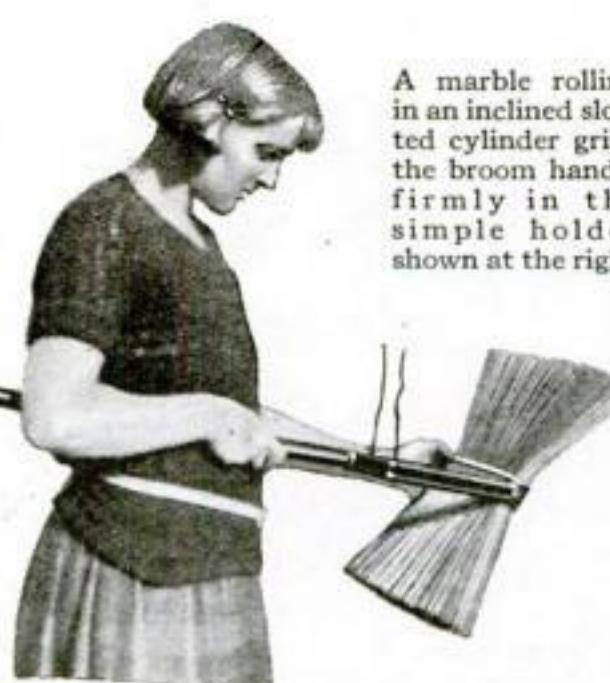
The unattractive chain switch for electric lights that often rattles against large shades can be eliminated with this extension, easy to install and to operate

Grasping the split handle of this iron causes the legs of its metal stand to fold up out of the way for ironing, as shown above. When the top half of the handle is released, a spring causes the supports to spring back, as at right. Various sizes are made

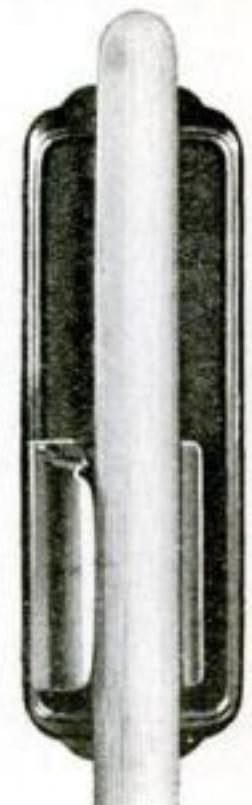


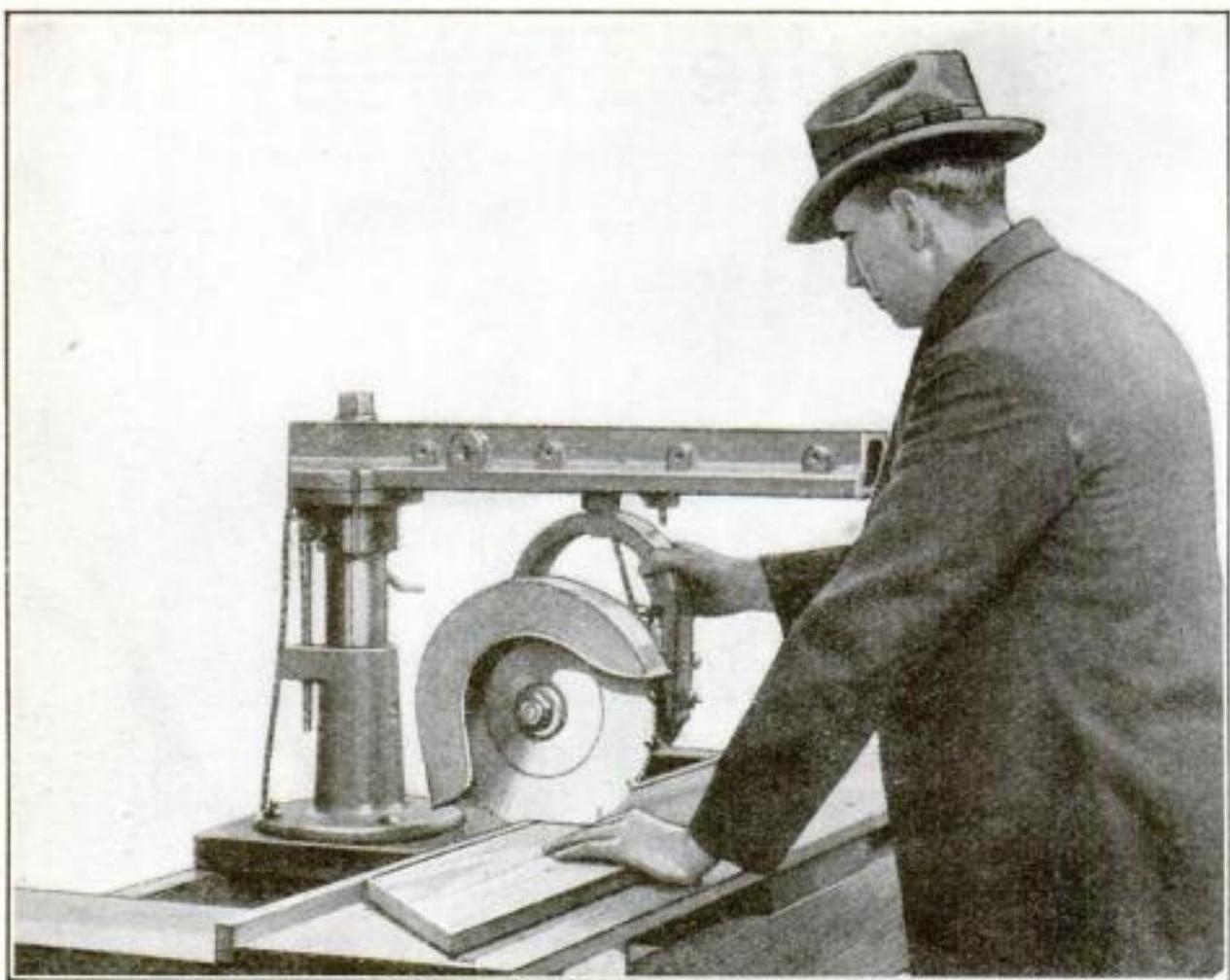
Broken corks are readily pulled with this device. The spring prongs are inserted so that the cork is between them and a twisting motion withdraws it from the bottle

The broom shown at the right has two sweeping ends. When one is worn, the other is brought into service by reversing the head



A marble rolling in an inclined slotted cylinder grips the broom handle firmly in the simple holder shown at the right





The electric bench machine with rotary saw attachment, used in cutting lumber



Weighted Strap Supports Ash Receiver

EVERY housewife who has had to clean tobacco ashes from the rugs knows by sad experience the trouble that is caused whenever an ash receiver topples from its precarious perch on the arm of a chair or davenport. To prevent just such accidents there has been invented a decorative weighted strap designed to serve as a convenient anchor.

The strap is weighted at each end, while the receiver is attached to it at the center by means of a spring clip. When the receiver is to be used, the strap merely is thrown over the arm of a chair, where it holds the receiver firmly without danger of spilling.

When the receiver is to be emptied, it can be removed from the strap almost instantly.

Electric Bench Machine Has Many Uses

AN ELECTRICALLY driven bench machine with a rotating toolholder adapted to work at any angle and to a great number of uses, recently has been developed. It consists of an electric motor and a horizontal carrier bar, together with necessary fittings for carrying tools.

The machine may be used for sawing, grinding, shaping, and tenoning. It also will carry lathe and jigsaw attachments, as well as a flexible shaft that permits its use for drilling of all kinds.

A "Human Radio" Theory

THE startling theory that every human being is a veritable wireless station, sending out waves of varying length that aid him in his daily work, is advanced by the famous inventor, Lakhovsky. He calls these waves "human rays."

Lakhovsky believes that eventually it will be possible to eliminate maladies by overcoming radiations of microbes, and that some day men may converse at a distance by directing their own waves.

Sprocketless Movie Machine to Save Film

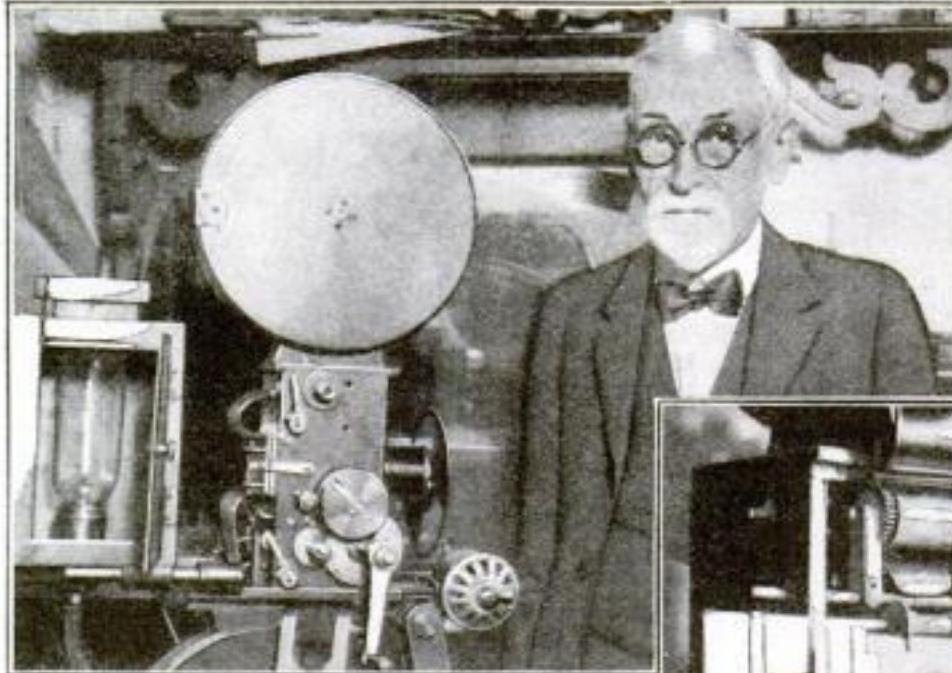
A NEWLY designed sprocketless motion-picture camera and projector device designed to do away with all sprockets and star wheels, thus eliminating the perforating of films, has been perfected by George W. Bingham of Brooklyn. He also is the inventor of the wideview and widescope motion-picture cameras.

The chief advantage claimed for the new machine is that it will permit a film to run more than three years without showing material signs of wear. Present-

day perforated film is good for only about three months. Another advantage is that the rollers are adjustable for shrinkage of film. Thumbscrews at the ends of two sets of rollers permit them to be expanded or contracted within a thousandth part of an inch.

An oscillator literally whips the film into shape, though gently, it is claimed, without tearing, doing the work that the star wheel does in the ordinary machine without jerking the pictures before the frame. It also is said to frame the pictures perfectly.

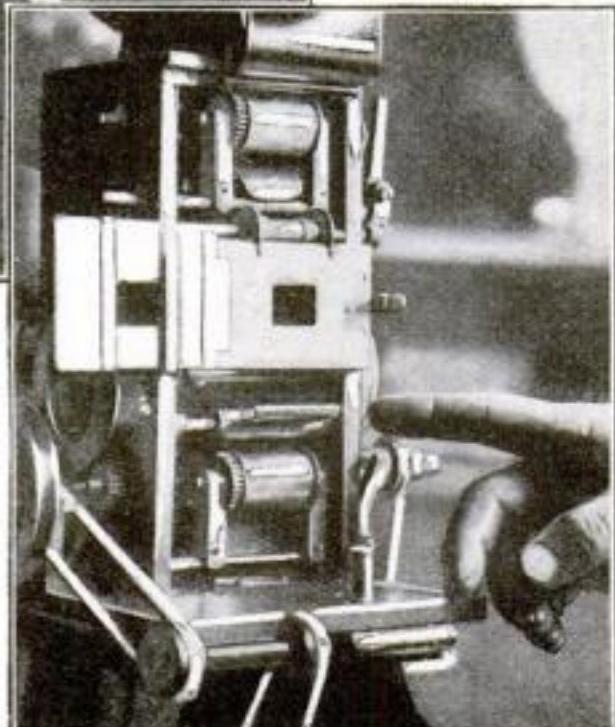
In addition, the inventor claims his machine will permit the projecting of old and worn-out film that has been shelved because the sprocket holes have become worn and torn



Above is the sprocketless motion-picture projector, with its inventor, George W. Bingham. At the right are shown the adjustable rollers and oscillator that carry the film through the projector

Signal Lights Save Diners

MINIATURE traffic towers are being used on after-dinner speakers' tables in New York to curb the flow of oratory. Amber and green lights warn the speakers that their time is about to expire, while a red light is a signal for a full stop.



Core Drill "X-Rays" Concrete Road

A FEW years ago it was a difficult problem to determine the thickness or cross-section composition of a concrete foundation or pavement. The general character of the concrete was learned by taking samples during construction, and whether these samples were representative or not depended on the inspector. The results of such tests often were of little value because inspectors sometimes worked with the idea that their services were judged by the perfect samples that they turned in.

This condition has been remedied by the invention of a machine that "X-rays" state highways or foundations. It consists of a drill that extracts from the pavement a small core showing the quantity and quality of workmanship and material, from the foundation to the upper surface. The test takes only 20 minutes and the small hole it leaves can be plugged up quickly.

Two advantages of the drill that performs this operation are the use of inexpensive steel shot for the drilling instrument instead of the costly black diamonds used in other types of core drills, and the ability of the machine to cut cores of ample size. The cores are actual records of the finished road, and any kind of modern road material can be tested.

The highway departments of Pennsylvania, Illinois, Ohio, and other states now operate these drills as part of their regular equipment.

Pneumatic Auto Springs Are Adjusted Easily

AIR-CUSHION springs to replace the usual elliptical springs for automobiles have been invented by James G. Hughes of Cincinnati, Ohio, who claims they offer greater resiliency, quicker action, and improved riding qualities.

Three inflated pneumatic rubber tires of small dimension are joined by aluminum rings or washers, which in turn are joined by a series of steel rods. Bolts and lugs for attaching to the car complete the apparatus.

Iron rods extending from one end of the car frame to the other and connected directly between the pneumatic springs and the car frame prevent side slipping.

Twenty pounds air pressure is sufficient for a large passenger car. For smaller cars only two sections of the cushion need be used and the air pressure can be regulated.



The pneumatic spring and its inventor



The road-testing machine extracting a cross-section core of concrete, as shown at the left

Novel Advertising Display Made of Glass Tubing

UNUSUAL display effects are said to be obtained by an inexpensive yet attractive advertising sign composed of a continuous length of glass tubing formed to any desired shape, through which brightly colored liquid continually dances.

This is accomplished by connecting the inlet end of the tubing with a tank



Map of England in colored tubing

of colored water. From the tank small quantities of water drop into a glass tube container fitted with a side tube air vent. The liquid falling into the container draws air through the vent, breaking the stream of liquid into continually moving bubbles that work their way around the outlines of the sign.

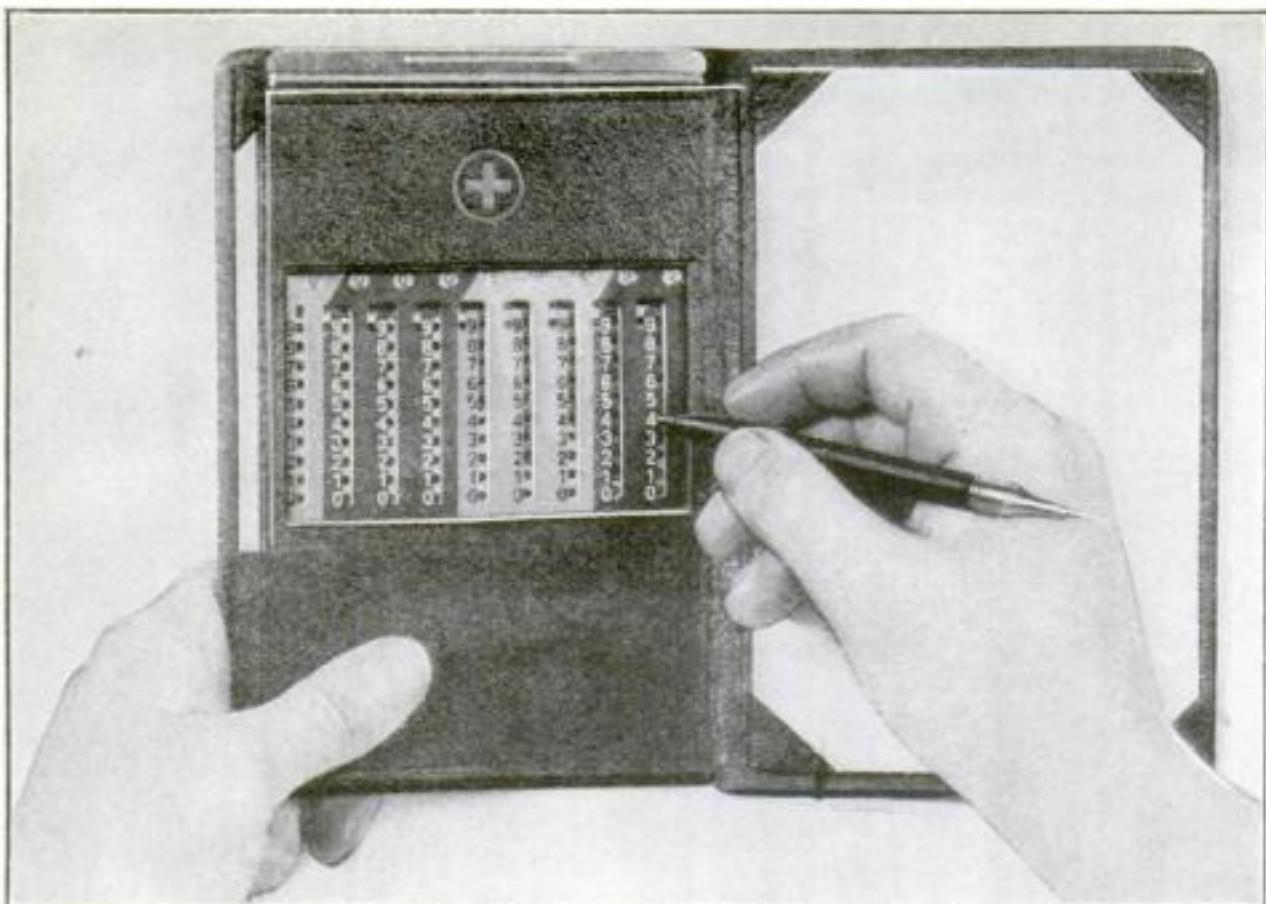


Telescope and Microscope in One Instrument

EMBODIED in this useful combination optical instrument is a prismatic telescope that can be converted quickly into an efficient microscope. All that is necessary to make the change is to attach a small tubular fitting that, like the telescope itself, can be carried in the vest pocket.

The original telescope insures a three or sixfold magnification, while the microscope amplifies 42, 84, or 180 times.

The same instrument may be used for examining small opaque objects, thus constituting what might be termed a telescopic magnifying lens.



Calculating Machine Carried in Pocketbook

AN INGENIOUS calculating machine that fits in the pocket and is operated merely by inserting a metal stylus in holes corresponding to figures and pushing the holes to the ends of their columns, adds, subtracts, multiplies, and divides. The machine is carried in a leather case, and is the size of a pocketbook and may

be used inside of a ledger if desired.

The top of the stylus is an automatic pencil that may be used for tabulating calculations. The machine contains no wheels or springs and does not require oiling.

Mistakes are recorded automatically. The result of calculations appears on both the addition and subtraction faces, so that debits can be added on one side and credits on the other. The final figure on the subtraction face shows balance due.

Electric Screwdriver and Wrench Combined

ANELECTRIC screwdriver and socket wrench, weighing but 15 pounds complete, has been perfected to speed production, cut costs and increase convenience on hundreds of jobs.

It is designed particularly for driving very large wood screws and lag screws and for running up nuts on large bolts. The spindle has a positive clutch that automatically disengages when forward pressure on the tool is released. The tool has a pistol grip and a trigger switch. Motors for voltages up to 250 are available.

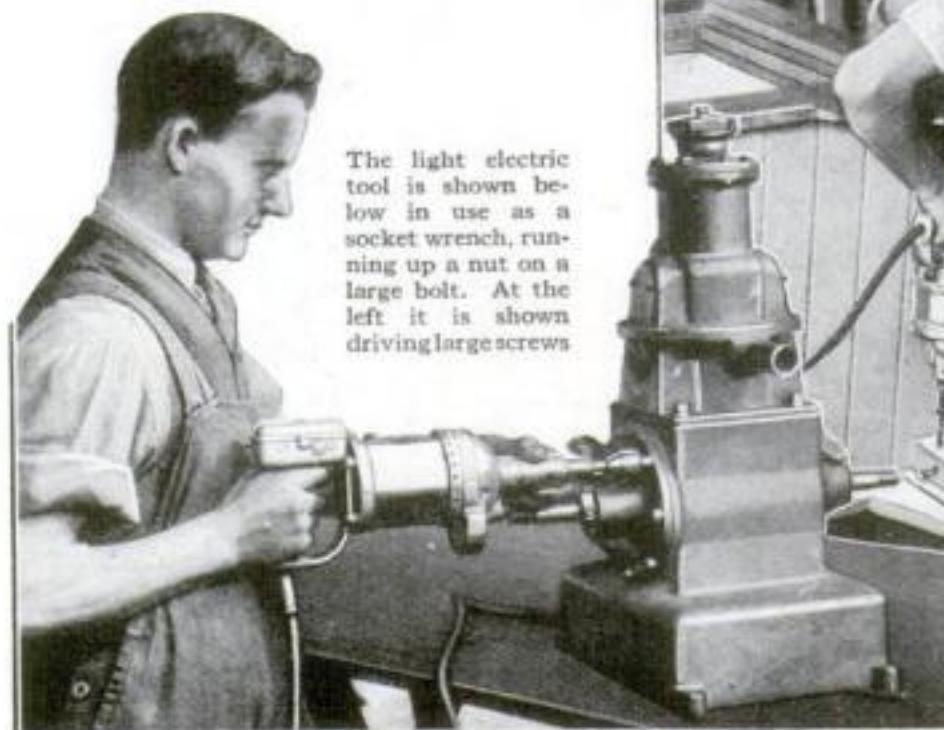


Simple Scraper Removes Mud from Shoes

TO KEEP mud tracks from the house and particularly from the parlor carpet and so save the housewife unnecessary labor in stormy weather, the simple but effective shoe scraper shown above has been devised. It is equipped with a long handle to obviate the necessity of bending in removing mud from the shoes.

The scraper is a double-edged metal knife attached to two metal prongs. The upper edge is used to scrape the soles of the shoes, while the lower edge is curved to fit the heels and uppers.

RECENT tests by the Society of Automotive Engineers and the U. S. Bureau of Standards showed that autos skid less on clean, wet pavements than on dry ones.

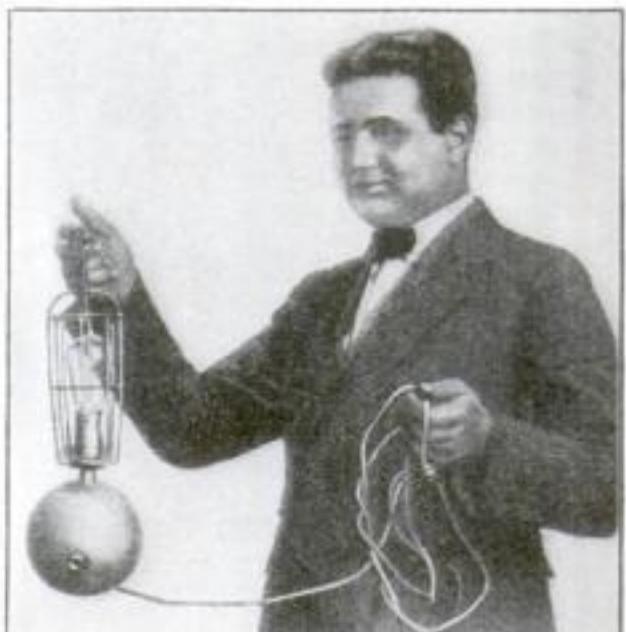


The light electric tool is shown below in use as a socket wrench, running up a nut on a large bolt. At the left it is shown driving large screws

Weighted Extension Lamp Always Stands Upright

DESIGNED especially for use in shops or garages where light is required in places remote from connections, a new extension lamp not only will right itself if overturned, but will pay out or reel in its own cord. A wire frame protecting the bulb is surmounted by a hook by which the lamp can be hung.

The weight of a ball base, which contains many yards of cord, causes the light to right itself. The length of cord desired is obtained simply by connecting with a socket and then carrying the light

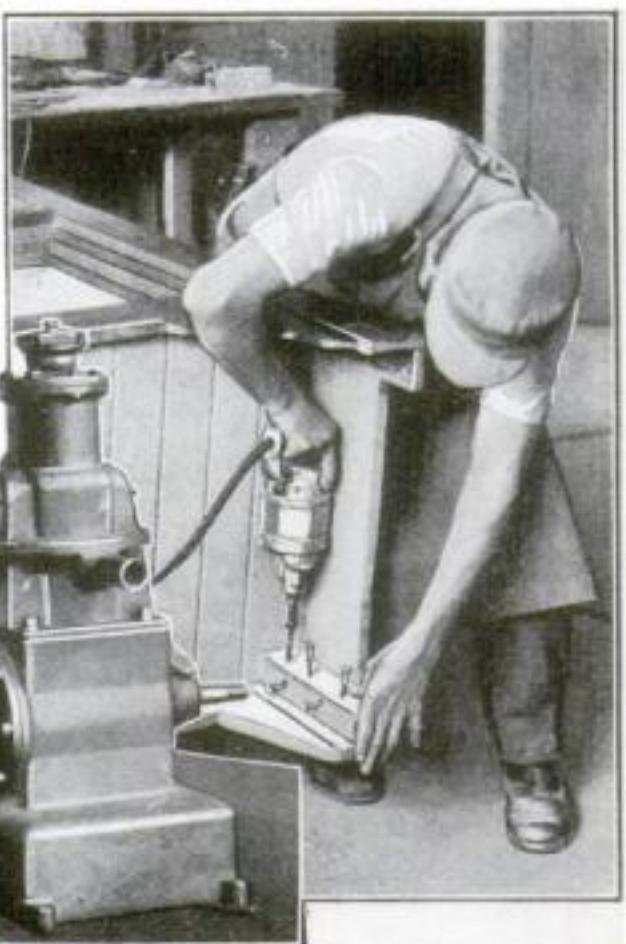


The complete extension lamp equipment

where it is needed, the cord paying out from a weighted spindle within the ball.

When finished with the light, the user disconnects it from the socket and rotates the wire guard, which draws in the cord, the weight, which is also rotating, aiding the operation.

STEAM from locomotive boilers is being used by the Southern Railway to kill weeds along the right of way. Passing through perforated pipes the steam hits the weeds at a high pressure.



Novel Pistol-Watch Fires Bullets through Stem

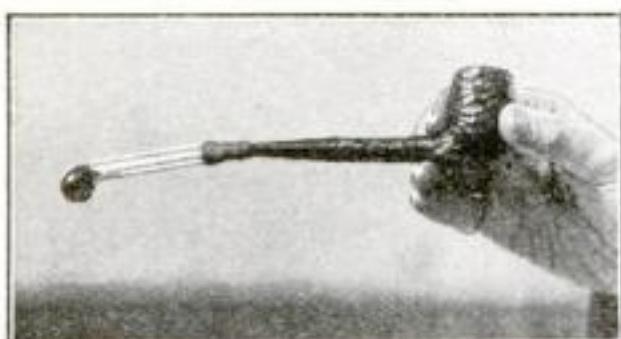
AS A protection against thugs, a French inventor recently designed a watch which, to all outward appearance, looks innocent enough, but which in reality is a small pistol, capable of killing at close range.

The stem of the watch serves as the barrel of the gun, which contains four bullets of small caliber. The bullets are fired by pressing a small trigger on the edge of the watchcase.



Ready to shoot

An ordinary watch guard is attached to the "timepiece" as a disguise.

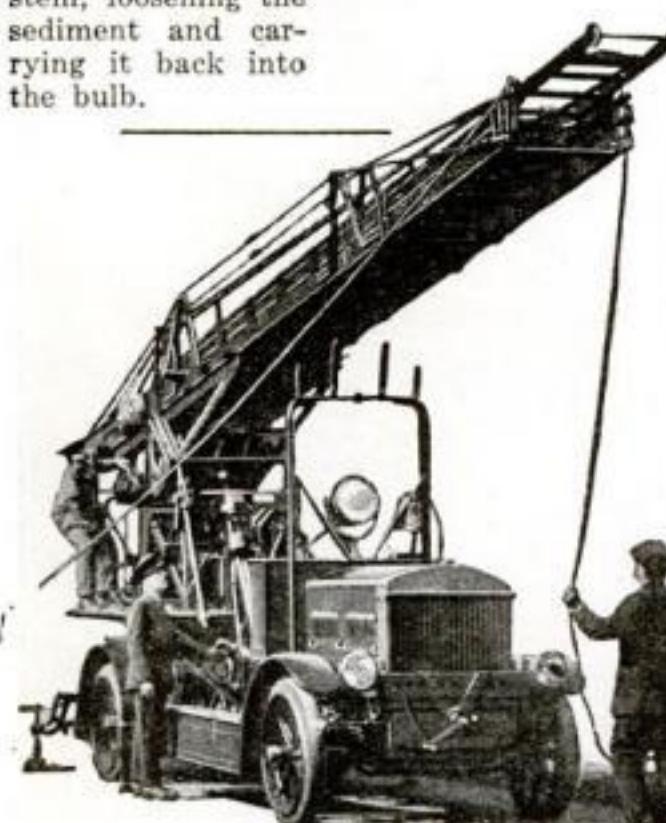


Alcohol as a Pipe-Cleaner

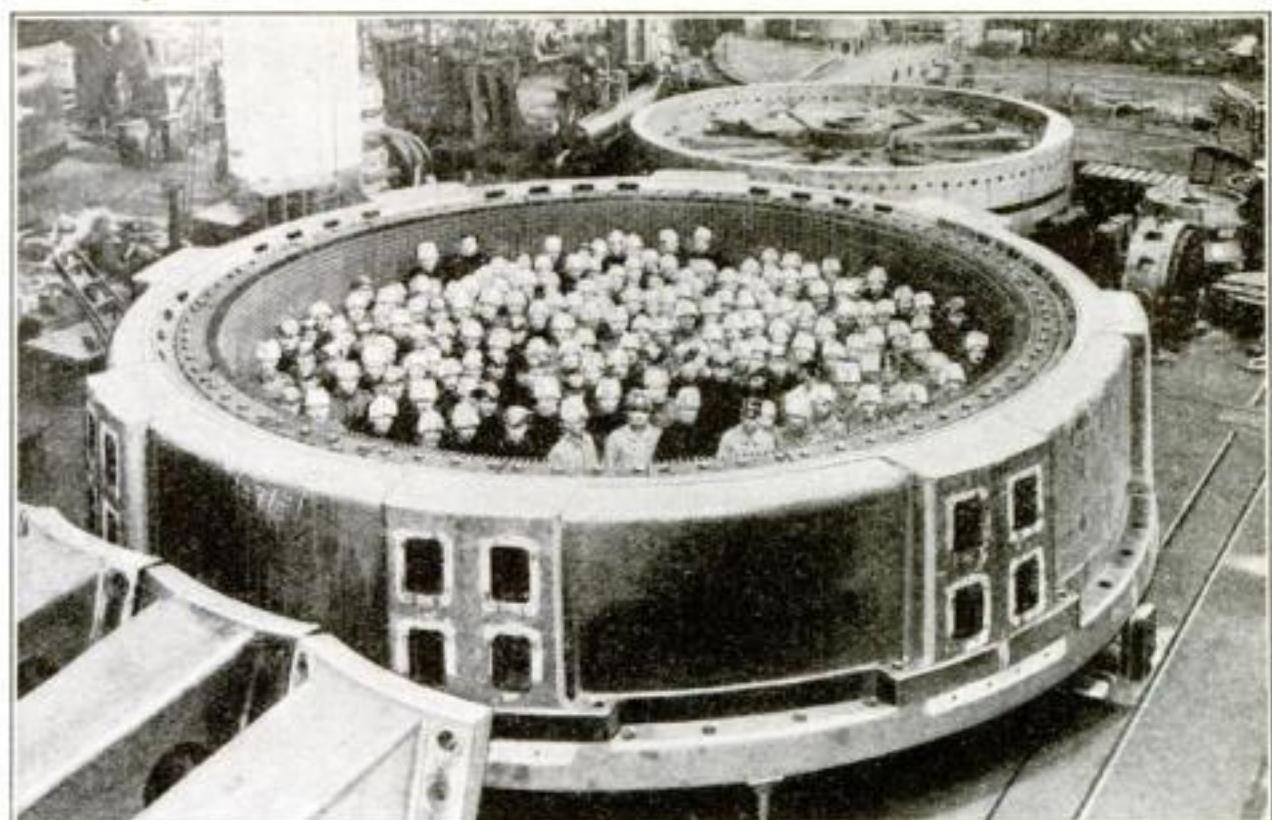
THE usually disagreeable task of cleaning a tobacco pipe that has been used for a long time is said to be accomplished thoroughly and quickly, simply by applying a match to the little device shown above.

It consists of a glass tube with a bulb at one end, attached to the pipe stem by a rubber tube.

The bulb end is filled with alcohol and heated for a few seconds over the flame of a match. The heat causes the alcohol to flow through the stem, loosening the sediment and carrying it back into the bulb.



The fire truck with its 85-foot ladder shown fully extended at the right



Huge Armature Holds Company of Soldiers

WITHIN this gigantic armature, a whole company of Swedish soldiers, 172 men, is seen assembled, with plenty of room to spare.

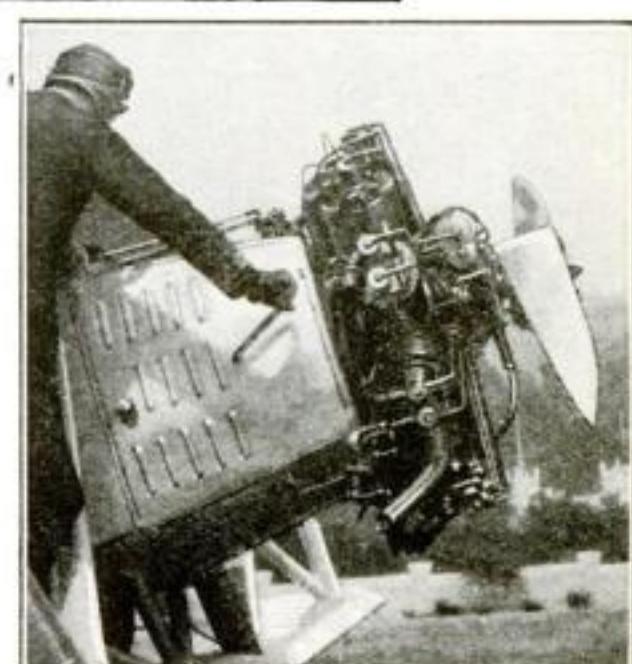
The 11,000-volt dynamo of which it is

a part will feed power to the Swedish State Railway. It is one of a number of huge dynamos being built for the Swedish General Electric Company, now tapping Sweden's enormous water resources.

London Fire Department Has 85-Foot Ladder

AN 85-FOOT extension ladder that serves either as a fire-escape or a water-tower, is the last word in equipment of the London, England, fire department. It is carried on a 65-horsepower motor-truck chassis.

The hydraulic pressure for raising, extending, and revolving the ladder on its turntable is provided by a three-throw pump at the rear of the truck, driven from the engine shaft. The ladder can be extended to its full height, it is said, in less than a minute.



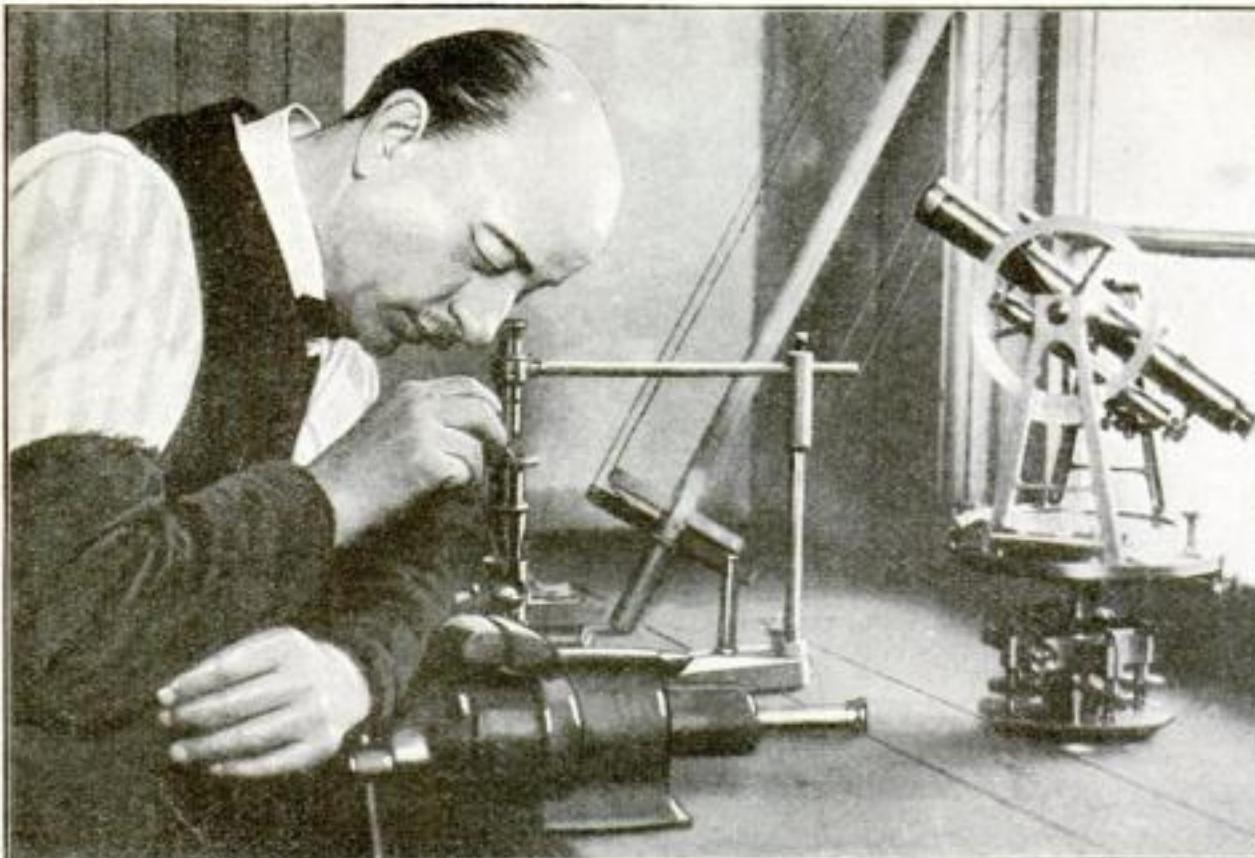
Airplane Hand Crank Aids Fliers in Starting

ORDINARILY, two men are required to start an airplane engine, one at the starting switch and one turning the propeller. Aviators forced down in uninhabited districts find it difficult and sometimes impossible to start their engines if they are operating the plane alone. For this reason, many planes of the latest design are equipped with cranks, resembling automobile cranks. These permit the aviator to turn over the engine while operating the switch.

Radio Velocity Measured

USING a motion-picture device, experts of the Radio Corporation of America recently succeeded in measuring the velocity of radio impulses. A radio signal was recorded as making a circuit of 8500 miles between the corporation's sending station at New Brunswick, N. J., and Warsaw, Poland, in .054 second.

A 14-tube receiving set was used.



His Business Is Collecting Spider Webs

SPIDERS usually are considered little more than a nuisance, but to George Hannes of Toledo, Ohio, pictured above, they have been the backbone of an unusual business for the past 35 years.



The World's Largest Shell

MONSTERS of the past and present are being mounted and cast in reproductions of their original form in a special department of the British Natural History Museum at London.

Huge models of prehistoric creatures often are made up from a few bones.

One of these is a restoration of the world's largest shell, shown above. It is a gigantic fresh-water shell standing higher than a man. The actual specimens on which the model is based were found in rock strata.

Two of the original fragments are shown. One of them is held by F. O. Barlow, who constructed the model.

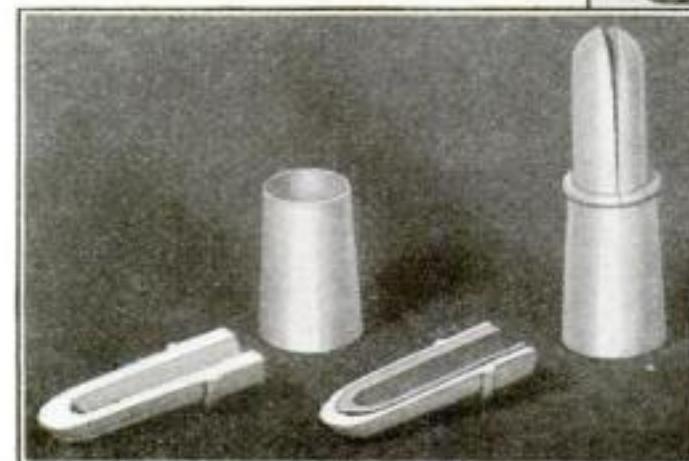
Hannes is a spider expert who collects spider webs for use in surveying instruments. The fine strands are the strongest and the thinnest obtainable. Since they are only about five ten-thousandths of an inch thick, they are said to serve better than any other substance for the cross hairs on the surveyor's telescopes or for field glasses.

The web is taken from the insects by allowing them to drop from a loom. As fast as they drop, the web, left behind, is wound on spools and placed in storage. A certain species known as the Michigan gray and brown spotted spider is raised for the purpose.

This Man-Made "Caw" Lures Crows to Death

BLACK days are ahead for crows. Hereafter not even the friendliest "caw" can be trusted. It may be a man-made lure calling them within gunshot. For a crow call said to imitate their cries perfectly has been invented for the use of farmers whose crops suffer from the black marauders.

Experts say that there are numerous variations of the "caw," such as a warning note and a call to feed. Therefore, the new lure is made so that the reed of the instrument may be taken apart and adjusted to give coarser or finer tones. A few hours spent listening to crows and watching the actions that accompany and follow their cries, it is claimed, will enable a hunter to understand and to answer them.



The Hard-Working Elephant Enjoys His Bath

AN ELEPHANT driver at Kandy, Ceylon, is shown below, giving his charge a thorough washing after a hard day's work.

Although it is not generally known, the elephant is one of the cleanest of animals and one of his greatest delights is playing about in water.

This one seems to be enjoying his bath thoroughly.



IN THE Siskiyou Mountains of California, forest rangers report the discovery of a tribe of Indians who communicate only by whistling and who can talk to birds.

Crows Find Little Sympathy from Farmers

Crows find little sympathy from the farmer. Not only do they destroy farm crops and raid poultry yards, but they are a menace to useful birds, whose nests they rob.

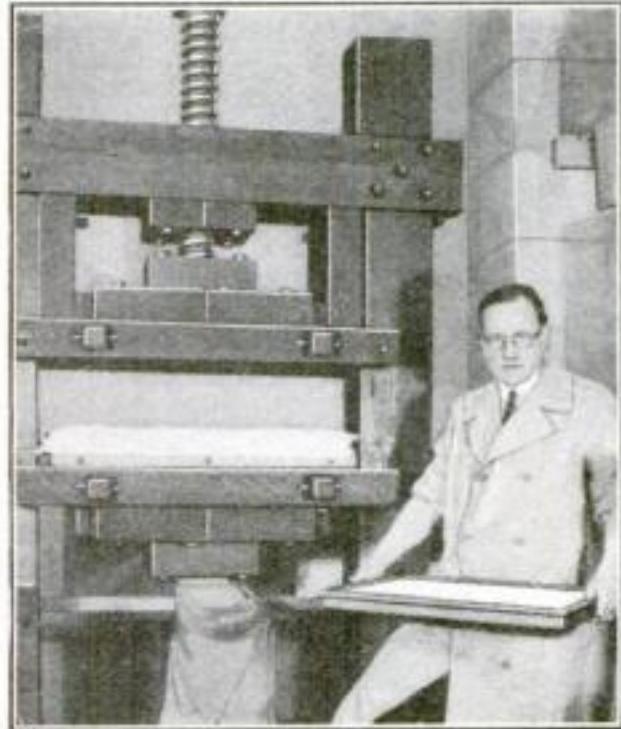


A farmer-hunter sounding the crow call with the ingenious reed instrument shown at the left. The instrument can be taken apart and adjusted to reproduce variations of the crow's "caw."

Writes, Prints, and Binds Books Single Handed

ONE of the most unusual "one-man jobs" in history was completed recently when Dard Hunter turned out 200 copies of a book on which he performed every task himself, from the writing of it to the finished volume.

The book—a history of papermaking—is the outgrowth of several years of research on the part of the author-maker.



The writer-bookmaker at his press

With his manuscript completed he made enough paper for 200 volumes, then cut, cast, and set his type, printed the edition himself, and finished his task by doing all the binding. The volumes are said to be examples of fine workmanship.

Midget and Monster in Armature Building

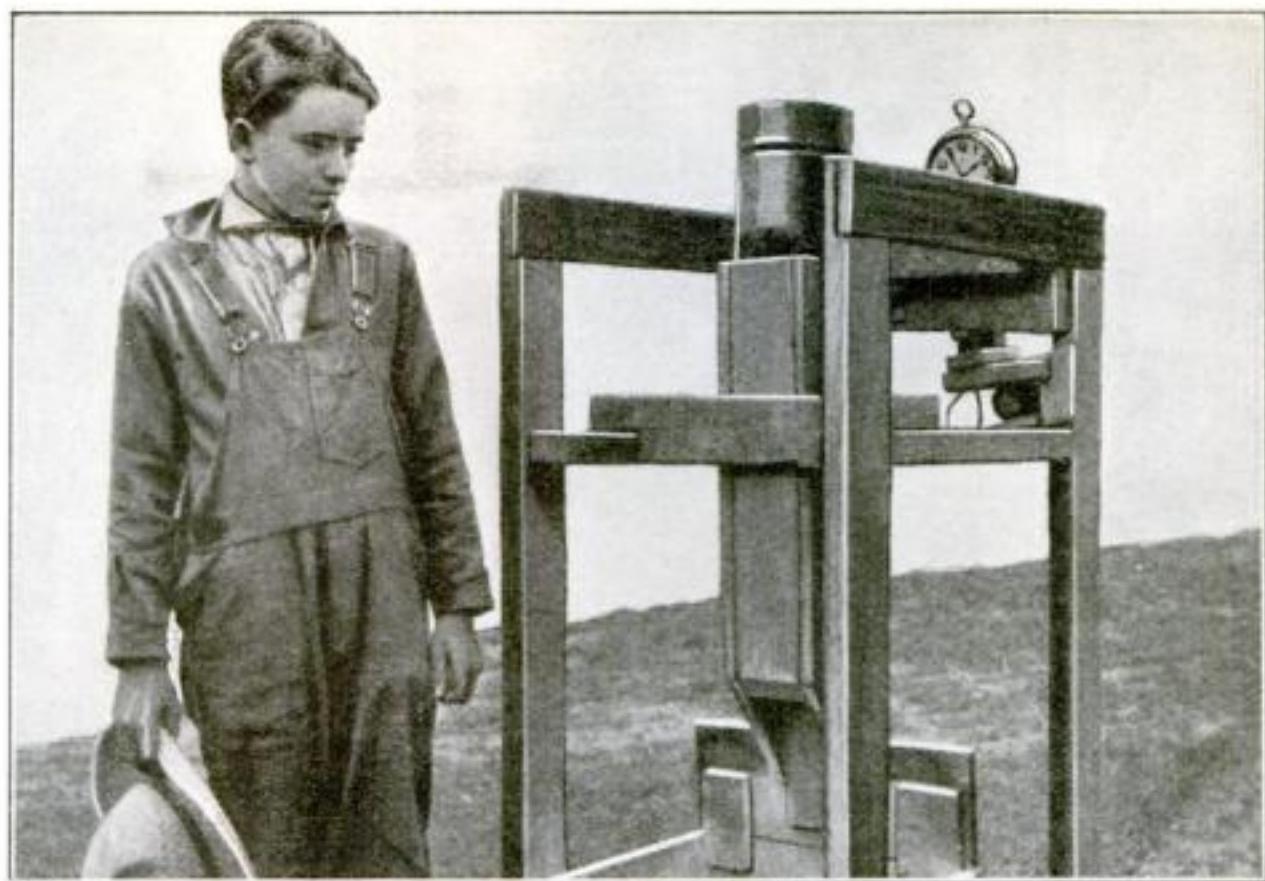
A STRIKING example of the most recent progress in the construction of electrical machinery is offered in the photograph below, which shows a giant armature weighing 96,000 pounds and a second one, equally complete, weighing $6\frac{1}{4}$ ounces.

Both armatures were assembled in the same building of the Schenectady Works of the General Electric Company.

The huge piece of apparatus is for a motor that is being constructed for use in a steel mill of the Ford plant. The motor of which it will be a part will develop 4500 horsepower, and the armature will revolve 67 times a minute.

The tiny armature winding that is shown in the hand of Miss Edith Bartlett was rewound by the service department for use in a small blower

The young woman in the picture is holding the midget armature



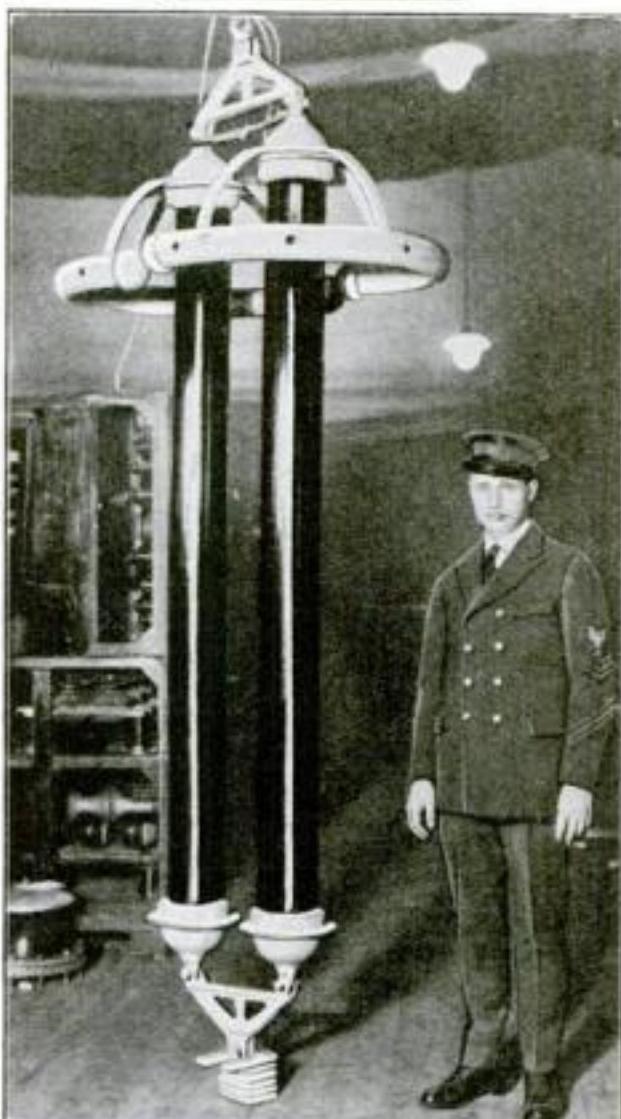
Young Inventor Feeds Calf by Clockwork

EVEN the farm animals are learning to keep step with the progress of science. In Wall Lake, Ia., a lad by the name of Robert Ralph owns a hungry calf whose feeding took too much of its youthful owner's time. So he perfected an automatic feeding machine with an alarm clock attached.

At feeding time the alarm rings and the calf comes scampering across the barnyard to his meal. The clapper on the bell releases a ball that opens a shoot and lets the grain from a hopper drop to a feeding trough below.

All Ralph has to do is fill the hopper

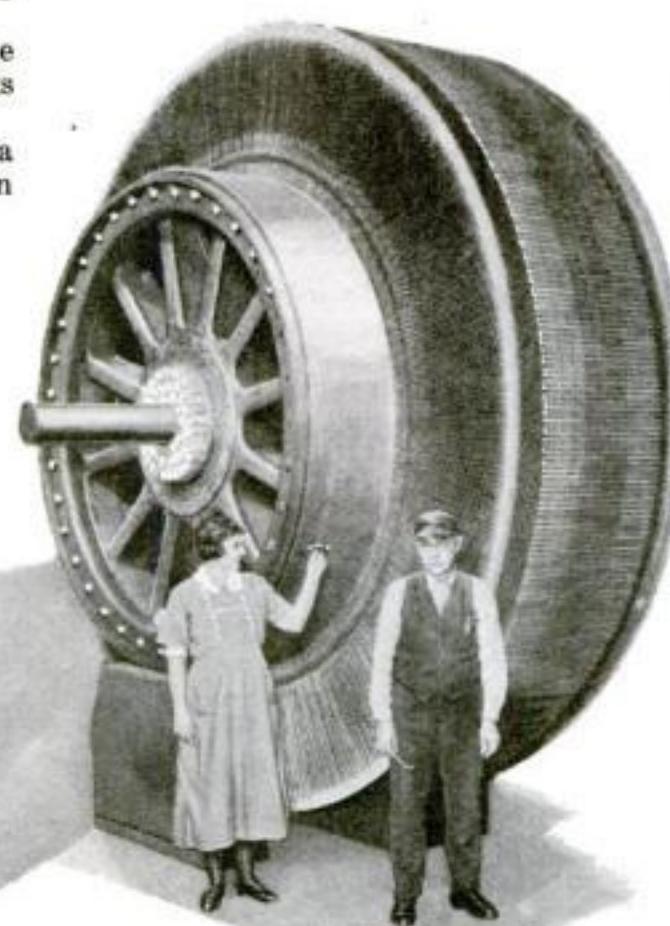
with grain, set the clock for feeding time, and let the calf do the rest. The young inventor is shown above with his ingenious homemade machine.

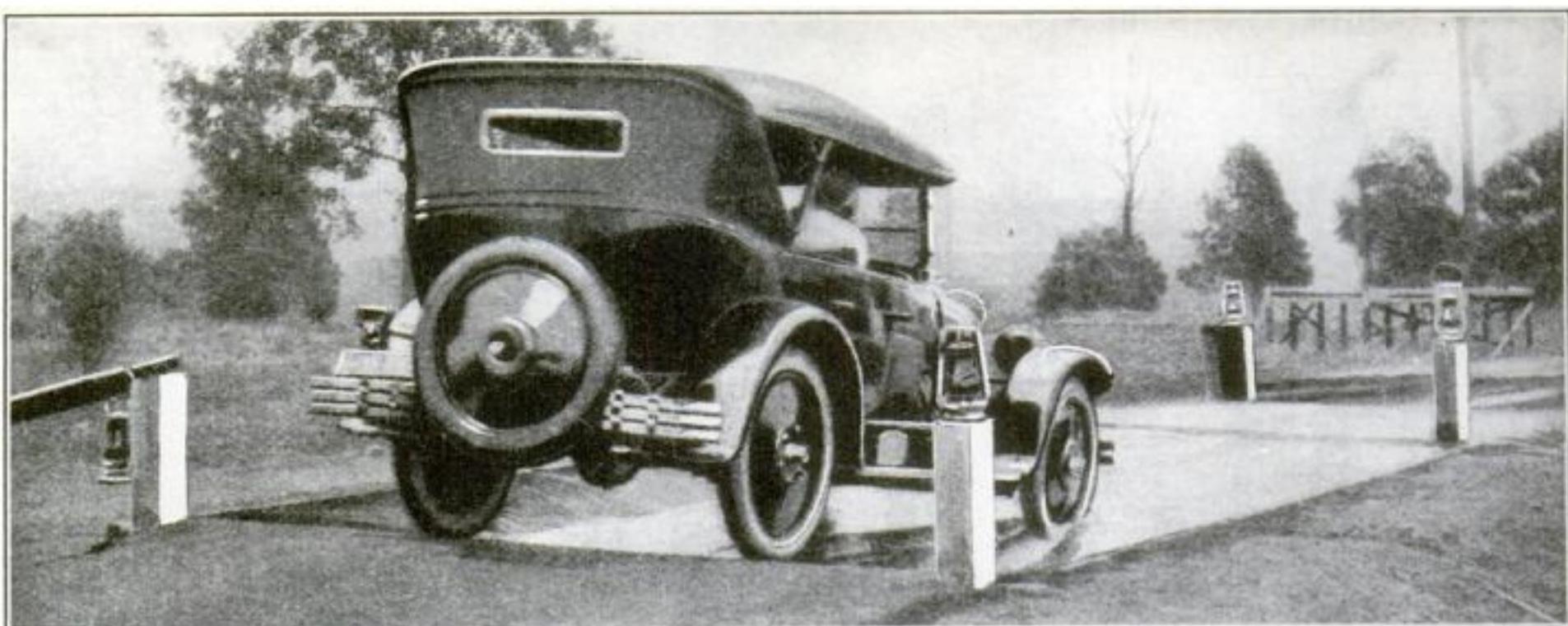


A Giant Radio Insulator

THE largest radio insulator in the world is used by the navy at high-power stations and is known as the Navy Type, SE-1560. It consists of two parallel porcelain rods six feet long, secured by yokes with shields attached to the antenna end.

The over-all length of the complete insulator, including yokes, is eight feet $5\frac{3}{8}$ inches. The working load is approximately three tons. Under test these units, flashed over, when wet, at about 460,000 volts at 60 cycles.





"Sheep Dip" for Autos to Combat Hoof-and-Mouth Epidemic

IN FORMER days of cattle epidemics, the four-footed creatures were the only ones subjected to rigorous disinfecting baths, but science today recognizes no dividing lines and includes the automobile in the list.

As a preventive against the further spread of hoof-and-mouth disease, which is threatening the live-stock industries of the state of California, where a statewide quarantine was declared, disinfecting troughs for cars have been placed at many

county lines, and all cars must use them.

In order to check the carrying of germs by man over broad areas in the state, every automobile must pass through shallow vats filled with strong disinfecting fluids before passing into the next county.



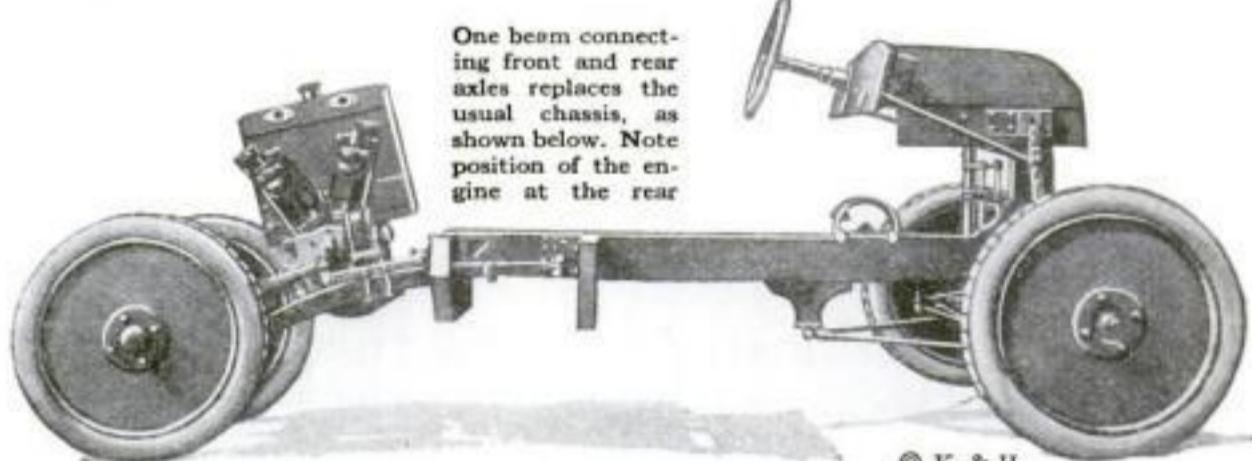
Kerosene Spray Designed to Clean Auto Engine

AKEROSENE vapor spray device for cleaning grease, oil, and dust from automobile engines and other machinery recently has been developed. It consists of a nozzle with a double jet, one of which is attached to the compressed-air line and the other to a kerosene can.

As the air is released from the airline, passing through the hose and out of the jet, it sucks up kerosene through the hose connected with the can. The cleaner is operated on the injector principle and a powerful spray of kerosene and air is thrown against the motor, quickly cleaning off dirt and grease. The flow of kerosene can be regulated at will.

After the engine surface is cleaned, the kerosene is shut off and the motor is dried with the air.

Lightweight Car Designed without Chassis



© K. & H.

IN THE production of a remarkable automobile without the usual chassis, a French engineer claims to have achieved an improvement that may have a revolutionary effect on automotive design.

Instead of the usual frame, a single beam connects the front and rear axles. The engine, instead of being under the

hood in front, is mounted in the rear.

Advantages claimed for this type of construction are that less material is required in construction, tire wear is lessened as the result of the decrease in weight, and transmission is improved. In addition, the narrower body offers less wind resistance.

Bicycle Lock Holder Attached Permanently

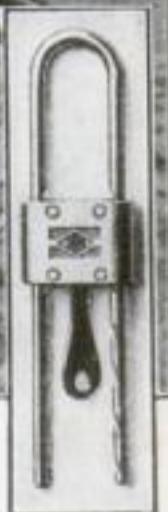
BICYCLES are safeguarded more conveniently against theft, it is claimed, with a new lock holder that is attached permanently to one of the rear frame supports and will work with any padlock of the proper size that has a hasp long enough to reach the opposite frame support.

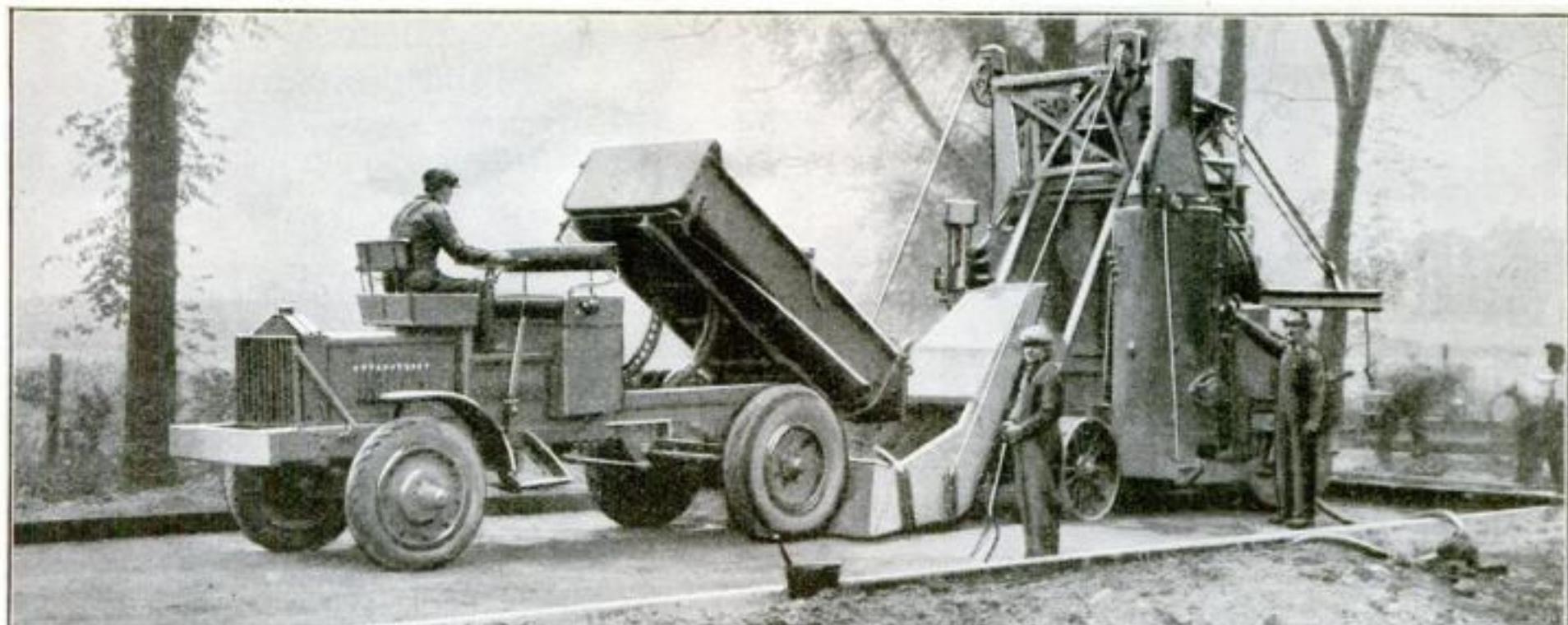
The sheath in which the lock rests hinges back when the wheel is locked, covering the heads of the screws that attach the holder to the frame. When thus hinged back, the sheath is closed at the bottom by a clip with two holes through which the two rods of the hasp are run.

A N ARTICLE on the thyroid gland, announced for this month, will be published in a forthcoming issue, owing to the fact that important additional material is in process of preparation by the author.



The new padlock holder is attached permanently to a rear frame support as shown above





Motor Truck with Two-Way Drive Designed for Road Work

DESIGNED especially for road construction work, a new two-way drive truck runs backward or forward with equal facility. In other words, it always can reach its objective in the most direct

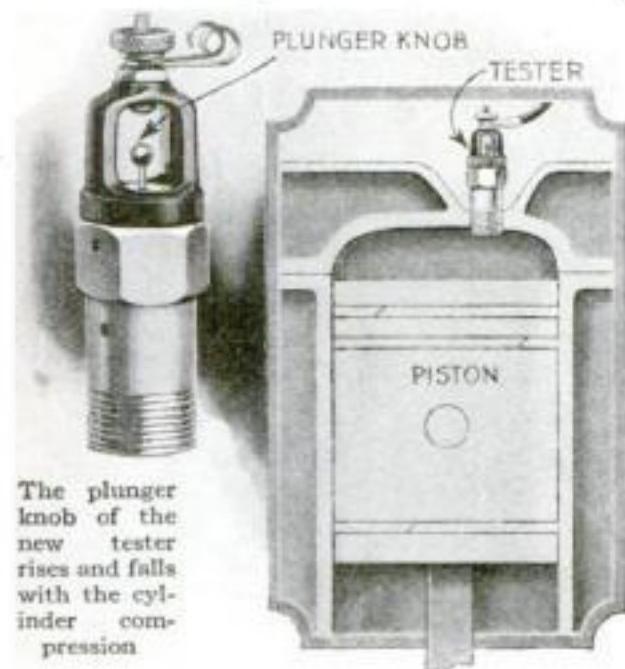
way without the necessity of turning around. Thus the necessity for filling ditches and removing forms for turning purposes is obviated.

In addition, the short wheel-base—128

inches—and specially arranged steering mechanism make it possible to turn the truck in an unusually short circle.

The machine is shown above dumping its load into a concrete mixer.

Testing Device Simplifies Motor Timing



The plunger knob of the new tester rises and falls with the cylinder compression

SO CLEARLY is the position of the piston in the cylinder indicated by a recently invented timing tester, that the user can time the spark and valves, besides determining quickly the correct firing order, enabling him to assemble the ignition wires properly—all without dismantling the engine.

The device consists of a balanced plunger surmounted by an indicator ball. These rise and fall with the compression in the cylinder. The upper part is used as a spark-plug terminal. Besides the usual binder nut, it has a new spring fastener that enables one to attach the ignition wire instantly.

The tester also determines precisely when the cylinder is ready to burn out carbon, for it indicates when the piston is at top dead center, with both valves closed.

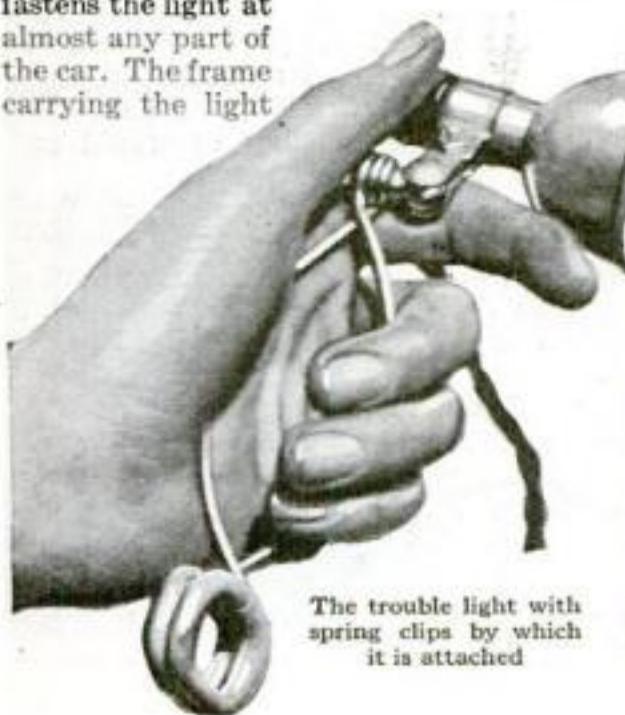
Portable Trouble Lamp Useful to Campers

FOR night repairs on the road or lighting an auto-camper's tent, this new portable electric trouble light is especially adapted.

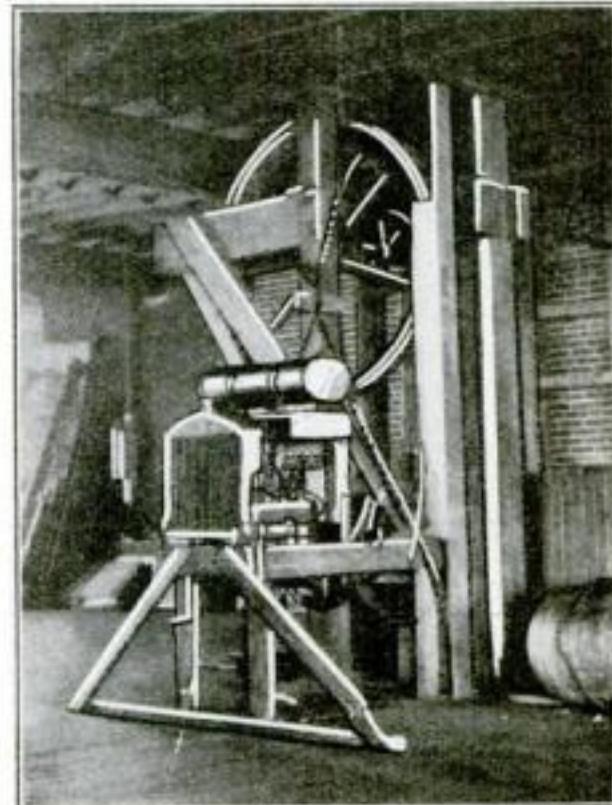
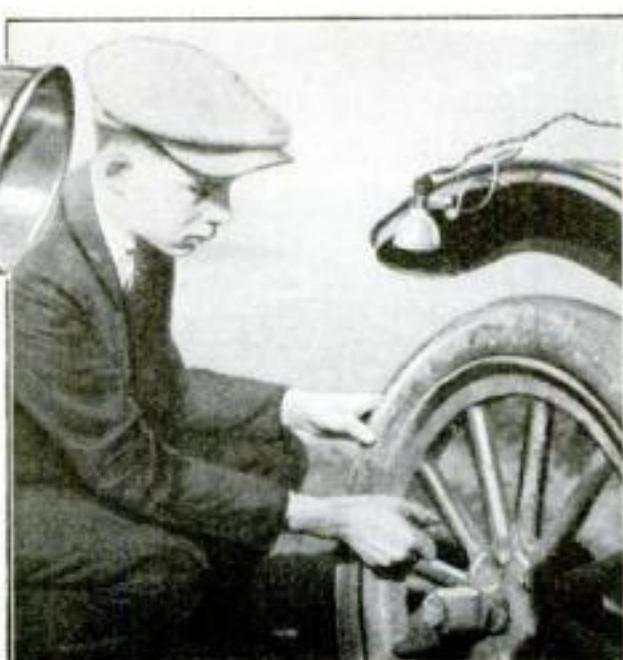
A heavy spring clip with rubber grips fastens the light at almost any part of the car. The frame carrying the light

can be swung in a complete circle, bent up or down, or set at any angle, throwing the rays exactly where they are needed.

A 10-foot cord plugs into any light socket on the car.



The trouble light with
spring clips by which
it is attached

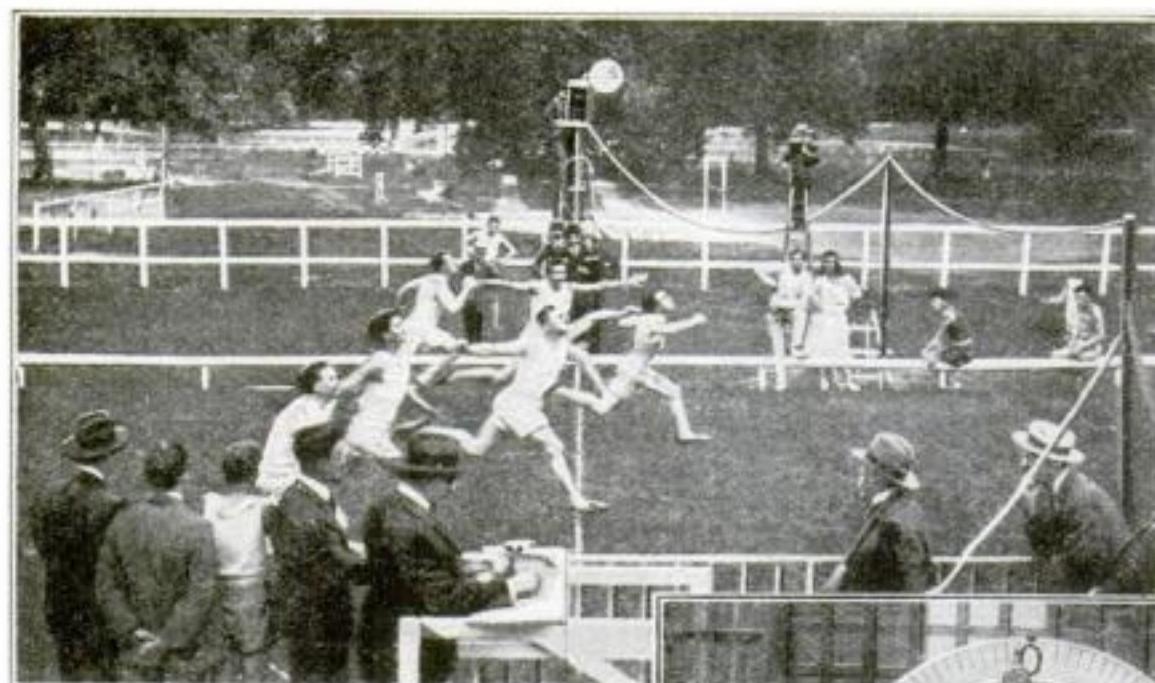


Auto Engine Used to Run Garage Elevator

THE Ford engine has been made to serve many purposes, but none more unusual than that to which an inventive garage owner has put it. He makes it drive an elevator that transfers automobiles from the first to the second floor of the garage.

The engine was mounted on a wooden framework and attached to the supporting beams of the elevator mechanism as shown above. A Ford rear axle shaft was squared at one end, fitted in the universal joint socket of the engine, and supported at the rear by a cross bar holding a rear axle roller bearing.

On the projecting end of the shaft was keyed a two-foot separator pulley. V-shaped wooden blocks were fitted in the rope groove of the five-foot elevator pulley, and an old belt running between the pulleys completed the unique and ingenious outfit.

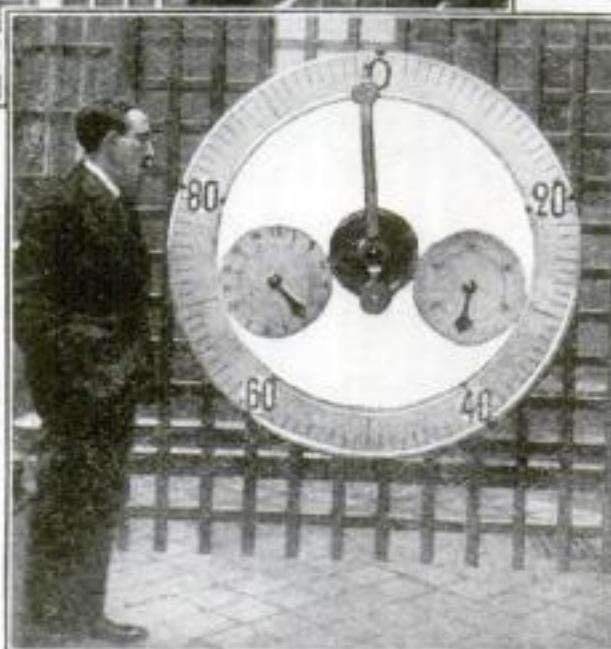


Crossing the finish tape, the runners are automatically photographed and timed by the three-dial clock shown at the right

Electric Clock Times and Photographs Runners

A HUGE electric clock with three dials, said to record time to one thousandth of a second, has been invented for important athletic contests such as the Olympic Games this summer. It can be connected with a camera so that a picture of the finish of a race is photographed, indisputably establishing the order of the runners, should a difference of opinion arise.

The clock is started by the firing of the starting pistol. Its hands are stopped the instant the runner breaks the finish tape. The clock and its hands are so large that the time can be read by many of the spectators; yet by means of its three dials it is graduated down to record fractions of a second.



GLASS so tough that when blown into a hollow sphere it can be kicked about like a football has been invented by Doctor Horak, a Czech engineer. While he does not claim to have found the secret of unbreakable glass, he declares his glass is tougher than any heretofore known.

How Much Science Do You Know?

SCIENCE is an indispensable part of our daily lives. There is a scientific reason for nearly everything we do and every article we use. How much do you know about the "why" of these things? For instance, every one knows that a soap bubble is always round, but can you tell why this is so?

Knowing the explanation of some of the hundreds of similar questions that come up daily will give you a liberal insight into science. Below will be found a dozen questions picked at random on various subjects. How many of them can you answer correctly?

After you have written down the answers to the best of your ability turn back to page 119 and see how nearly you are right; but don't read the correct answers until you have considered each question thoroughly.

Then try them on your friends. There will be 12 more questions next month.

1. Why is a man usually stronger than a woman?
2. How could you start a fire if you had no matches?
3. How large is the earth in thickness and circumference?
4. Why are there no fish in the Dead Sea?
5. What are icebergs and how are they formed?
6. Why does a wood fire snap and crackle?
7. What is the largest living animal on earth?
8. Can plants see?
9. What was the first metal to be used by man?
10. Where did the American Indians come from?
11. How does a towel dry your hands?
12. Why is the formation of a soap bubble always round?

Metal Bucket for Berry Picking Saves Fruit

BERRIES and other soft fruits can be picked more conveniently and with less loss from bruises, it is claimed, with a new bucket designed to hang from a band across the picker's shoulders.

The metal container, open at the top and bottom, incloses a canvas bag that also can be opened at both ends. While the bucket is being filled, a ring attached to the edge of the bottom mouth of the bag is engaged by a snap near the top of the metal body on the front. This closes the bag.

When the bucket is set on the ground, it rests on supports that keep the bottom of the bag from touching the ground, and thus prevent bruising of the fruit. The metal body also protects the fruit from side blows or pressure.

The snap and ring are disengaged when the bucket is to be emptied, opening the bag and allowing the fruit to be deposited gently in a receptacle.

The bucket has a concave back conforming to the picker's body.



The new bucket with canvas bottom open

Ocean Flight of ZR-3 to Mark Aerial Progress

WITHIN a few weeks the great dirigible ZR-3, built by the Zeppelin Company for the United States Government, is expected to fly from Friedrichshafen, Germany, for America. No more thrilling illustration of the progress of modern science probably could be furnished than this of an airship undertaking a perilous voyage across the Atlantic quite as readily as would an ocean liner.

The ZR-3 is the first passenger-carrying airship, designed for other than military purposes, to be built for use in this country. In design and construction she is said to be the most beautiful and luxurious airship ever built. She is 656 feet long and 90.7 feet in diameter—not 985 feet in length and 130 feet in diameter, as erroneously stated in a recent issue of this magazine. Her total volume is 2,400,000 cubic feet.

Her five engines of 400 horsepower each are capable of driving her at a speed of 75 miles an hour.

New Safety Plug Drains Water from Gas Pipes

THE dangerous stream of escaping gas that often accompanies removal of water from gas pipes is avoided, it is claimed, by a new draining plug which allows the water that has accumulated in the water trap to be drained without removing the plug or allowing any gas to escape.

The new cap is similar to the usual plug with the addition of a small nipple inserted in the bottom. In the end of this is a small lateral opening and a revolving sleeve with cap that opens or closes the vent.

To drain the water from the trap it is necessary merely to turn the collar to open the vent. The gas pressure forces out the water through the vent in a small stream. After the water has completely run out, a slight twist of the collar prevents any gas from escaping and does away with the trouble of removing the entire plug.



Draining the water through the vent

Recent Publications

A résumé of new books on science and invention

Autocamping, by F. E. Brimmer. A comprehensive, practical handbook written from the experiences of a pioneer in this fascinating outdoor pastime. Illustrated. D. Appleton & Company.

Everyday Biology, by J. Arthur Thomson. A popular and unconventional introduction to the study of living things by the noted editor of "The Outline of Science." George H. Doran Company.

The Kingdom of the Stars, by Charles Nordmann, astronomer of the University of Paris. The enthralling story of the wonder of the heavens told in popular language. D. Appleton & Company.

The Humanizing of Knowledge, by James Harvey Robinson. A discussion of the necessity for a common ground on which science and the ordinary man may meet. George H. Doran Company.

Technical Writing, by T. A. Rickard. Specific instructions on the preparation of manuscripts on scientific subjects. Second Edition. John Wiley & Sons.



The inventor attaching his pocket fire-escape preparatory to his descent from the eighth story (at the left)

750 pounds. It is unwound from a little wheel inside the case, the speed of release being regulated by a brake. A strap fastened around the body attaches the "fire escape" to the user.

Vescovi bravely demonstrated his device before half a dozen police and fire officials while a large crowd in the street watched his breath-taking descent.

Drops Eight Stories in Vest Pocket Fire Escape

THE proof of the pudding is in the eating and the success of a fire escape lies in its utility. To prove his faith in his invention of a "vest pocket fire escape," Peter P. Vescovi crawled out of an eighth-story window of a New York hotel recently, attached his device to the small railing just outside the window and safely descended to the ground.

The "fire escape" consists of a compact roll of 75 feet of steel tape tested to hold

Birds Still Champions

FOR untold ages before the American round-the-world fliers started on their adventurous trip, certain birds called "arctic terns" have been making a trip of 22,000 miles each year from their breeding grounds in the north polar regions to feeding grounds in the antarctic, and back again. Man still has some distance to go to match the birds' records.

Know Your Car

When the Starting Motor Jams

THE occasional jamming or locking of a starting motor is a problem that usually baffles the auto driver who fails to understand that it is chiefly his own fault. If the priming rod is not pulled out long enough in pressing the starting button or foot switch, not enough gas is drawn into the cylinders to fire all of them.

The result is that if the engine is cool, the motor turns a revolution or so and when the unfired cylinder is on the compression stroke, the piston compresses the charge and rebounds, turning in the opposite direction.

When the foot presses the switch at this time, while the flywheel is turning in the reverse direction, the pinion is thrown into engagement and the two oppositely turning gears—the starter gear and the flywheel gear—are engaged. Since one cannot overcome the inertia of the other, the

result is that the compensating spring is locked tight with the gears in mesh.

To avoid this, the operator should not press the switch until the motor has time to come entirely to rest.

The best way to free a locked gear is as follows: Engage the high-speed gear with the clutch in and the ignition switch thrown off. Now grasp the spokes of one of the wheels, and turning this wheel as if to move the car forward, take out all the lost motion. Then quickly turn in the opposite direction as if to back the car. Try this several times, making an effort to increase the movement of the car each time by applying more effort.

Usually the motor can be disengaged by this method and the labor of removing the starter can be avoided.

Adventures in Home Ownership

We Plan Household Equipment, Specifications, and Contracts

THIS is the fourth article in Mr. Riley's interesting series describing the home-buying adventures of Jim and Marion Hunter. In preceding articles, Mr. Riley told of their house-hunting expeditions, of their purchase of an inexpensive ready-built home to live in until Jim's expected salary increase should materialize, and finally of their selection of the building plans for a permanent home.

In the following article, the story of the Hunters is concluded. When you have read it, you won't want to miss an equally readable series on how to save money in building a house, beginning next month.

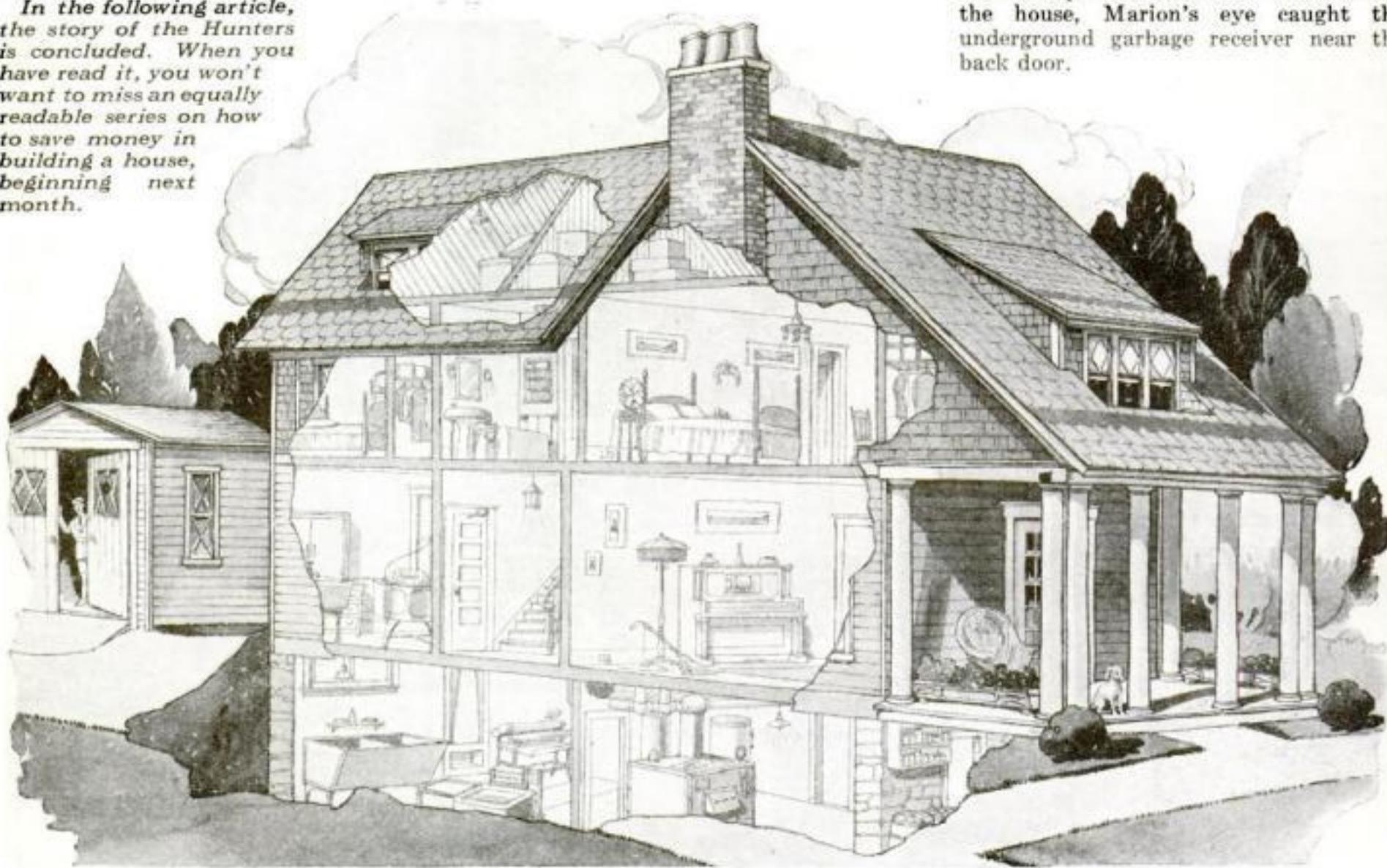
By Phil M. Riley

Noted American Authority on Architecture and Building

ting the building contracts," Marion chimed in. "Possibly, too, you can give us some ideas on equipment that might help in rounding out completely the specifications for our new home."

on the roof and screen wire. In building a permanent home, it pays in the long run to buy the most enduring materials. Don't think of using ordinary building bricks for your chimney and fireplace. The various tapestry types have a delightful texture and variety of color that are well worth the slightly additional price."

As we passed around to the back of the house, Marion's eye caught the underground garbage receiver near the back door.



The house that Jim and Marion built, broken away to show arrangement and equipment of the rooms on one side. Note how the cellar is divided by partitions into several rooms, this view showing the laundry with its electrical equipment, the heater room, and vegetable cellar. The kitchen in the rear of the first floor has a large white

enamel sink and drain table, also white enamel electric dishwasher. All rooms are plentifully supplied with plug sockets for lamps, vacuum cleaner, and other electrical household devices. Notice the electric fan connected with plug socket in the front bedroom. Ample storage space is provided in the roomy attic, which also contains maid's room and bath

FULLY two weeks had elapsed since I had heard from Jim and Marion Hunter about their proposed new home. It was no surprise to me, therefore, as I sat on my screened porch reading the paper one Sunday morning recently, to be hailed cheerily from an approaching motor car and presently to see Jim and Marion hurrying toward me across the lawn.

"We've bought the land!" announced Marion breathlessly, sinking into the couch hammock at my side. "Half an acre of it."

"As usual, it's a compromise," laughed Jim. "Marion wanted to be in a thickly settled suburb; I in the country. We've located just where the two seem to meet, and land enough for lawns, flowers, and a garden is not too expensive. The alterations in the plans are complete, specifications are being drawn, and we expect to be ready to start building soon."

"And we thought that perhaps you'd have a few suggestions to offer about let-

"You bet I can," I assured them, adding the suggestion that, if they cared to look, I might show them some of the things that had given me pleasure in my own home. And so we strolled out into the yard, where we began with a discussion of outdoor specifications.

"Your house, like mine," I said, "is going to be shingled. Use cypress. It's the most lasting of woods. Dip the shingles in shingle stain before laying and never paint them. Paint on a shingle surface encourages dry rot under it. You can get a cream or the good old plantation white in a creosote stain that sinks into and preserves the wood, and it can be used on both the shingles and trim."

"LET me urge you also to have a slate roof," I went on. "It costs more at the start, but it's permanent, fireproof, and of excellent appearance—a good investment. The same is true of copper conductor pipes, flashings and valleys

"That is a good thing, isn't it?" she asked.

"Where garbage collections are dependable, it's the best arrangement," I answered; "otherwise an incinerator is desirable. See, it opens with the foot like this, and the pail comes out for emptying. Dogs, cats and flies have no chance to get at the garbage and a clean service yard is assured."

"WHAT'S that?" asked Jim, pointing to a metallic door in the basement wall near the garage driveway.

"That's my coal chute. See, the heavy steel hopper drops down and catches all the coal, while the door opens and fastens upward, protecting the building where it's most needed—no blackened and battered sash and window frames."

"How about locking it?"

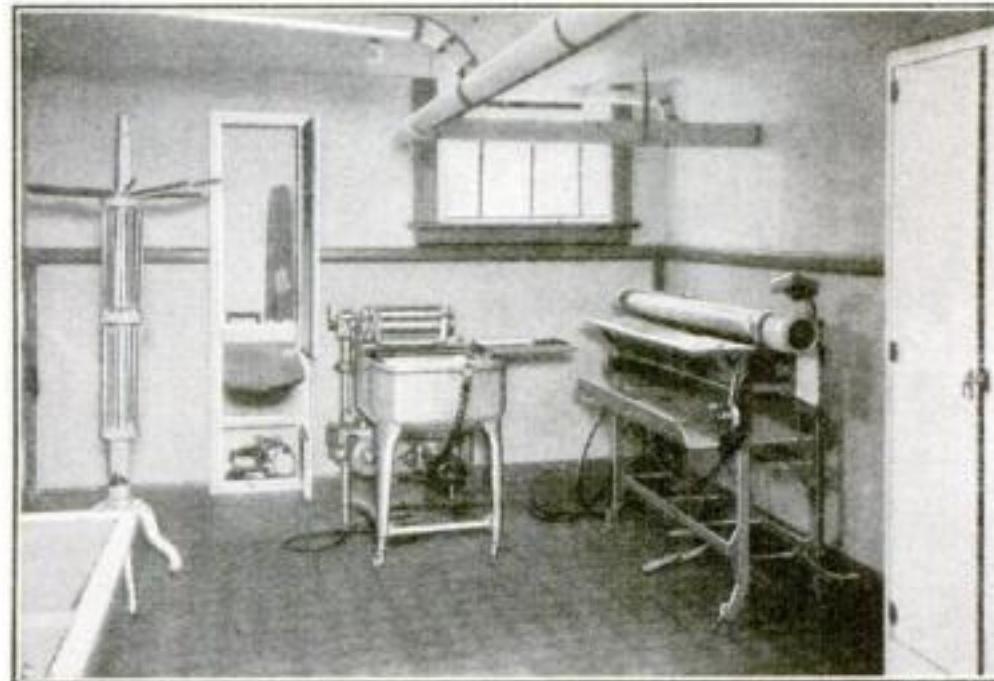
"Upon closing the hopper, it locks automatically on the inside, and is double locked by a special key on the outside. When not in use, the hopper lies in the

chute body, out of everybody's way."

From the yard we entered the cellar.

"How do you keep it so clean?" was Marion's first comment as we descended the stairs.

CONCRETE foundation walls and floors are a great help," I told her; "but the real secret lies in dividing the space into several rooms by wood partitions. Here at one end of the house, you see, is the heater room in which is located the heating plant, coal bins, space for ash barrels and a full height basement door where the ash barrels are taken out. Here also the pit under the living-room fireplace is emptied. This



Courtesy Home Owners' Service

The neat laundry in the basement, showing electrical washing machine and mangle, set tubs, built-in closet for ironing-board and iron, and multiple clothes-rack at the left. The floor is of waterproof rubber tile

keeps all ashes and coal dust away from the rest of the cellar."

I pointed out how the hot-water furnace and all the pipes were covered with asbestos, explaining that although this provision costs little, it insures the heat's going to the rooms above instead of being wasted in the cellar. I described, too, the automatic heat-regulating system.

THE regulating dial is in the living room above. You simply set the dial for the temperature you want, keep the fire properly tended as to coal supply and removal of ashes, and the regulator keeps the drafts set to maintain the desired temperature day and night."

"Isn't it wonderful!" cried Marion.

"Yes, and there is another interesting thing about my heating plant," I continued. "Behind every radiator in the house hangs a special container kept full of water that gradually evaporates and maintains normal humidity of the air. This makes for better health, fewer colds, less throat trouble and helps to preserve woodwork and furniture from overdrying with consequent shrinkage and pulling apart."

From the furnace I led them to a door opening into the vegetable cellar, under the sun porch where a garage often is located. I explained how this cellar is kept cold by a concrete partition separating it from the rest of the cellar, and showed them the shelves along the sides, for preserves and canned goods.

"Your laundry is in the basement, too?" queried Marion.

"Yes," I answered, leading the way. "This, you see, is another separate room of ample size for the set tubs, an electric washing machine, and a mangle."

Next I called their attention to two electric plug sockets for the laundry machinery, and a gas connection for the mangle.

"You'll want plenty of these plug sockets throughout the house," I reminded them. "There should be at least one and preferably two in the wall, baseboard, or floor of every room. Remember this is an electric age and provision must be made for floor and table lamps, fans, portable heaters, vacuum cleaners, piano players, irons, toasters, coffee percolators, chafing dishes, waffle irons and grills, also various bedroom and bathroom devices."

"I suppose," hazarded Marion, "it would be a good plan to furnish each room of our house on paper, so to speak, and plan the electric wiring accordingly before the house is built."

"That's the point exactly, and a good way to save money," I agreed.

Upstairs, Marion was delighted with the kitchen arrangements, es-

specially the flooring and baseboard of rubber tile with three-tone grain effects like marble. She was impressed, too, with its sanitary, noiseless, non-slippery, waterproof, and durable qualities. Other features that caught her eye were the large white enamel sink with combined draining table, and the white enamel electric dishwasher that when closed served as a kitchen table.

"Now I want you to look at my windows," I said, as we entered the dining-room. "All are hung on metal chains that never rot and break nor come unfastened like cotton cord. These are pivot windows, you see. Each sash slides up and down, yet it also can be swung inward for cleaning both sides. Notice also how smoothly they slide and how tightly they fit in those metal weather strips. That means winter comfort and a saving of several tons of coal a year."

"Your front door also is well protected, I noticed," commented Jim as we passed to the living-room.

"Yes, it has wood weather strips all around it, and that glazed vestibule on the front porch keeps much of the cold out in winter. It's a great comfort when somebody comes to the door for a few minutes, and it really adds distinction to the appearance of the house."

"What a delightful great fireplace!" cried Marion enthusiastically.

"Yes, it is," I agreed with some pride. "And that reminds me of a caution I want to give you. A fireplace that smokes is an abomination. Two precautions will prevent it. Make sure that yours has at the back of its throat a smoke shelf of ample width to deflect the down and start the up draft, and that the cross sectional area of the flue lining is not less than one-twelfth the area of the fireplace opening. You'll need a flue damper. Notice how easily this one is controlled outside by this unobtrusive little brass knob."

GOING up to the second floor, I again called attention to the plug sockets in the halls for table-lamp and vacuum-cleaner use, and I pointed out the economy of having most of the plumbing centralized practically in a vertical line at the back of the house, the laundry below the kitchen, the hall and master's private baths above, and the maid's bath on the third floor over the hall bath.

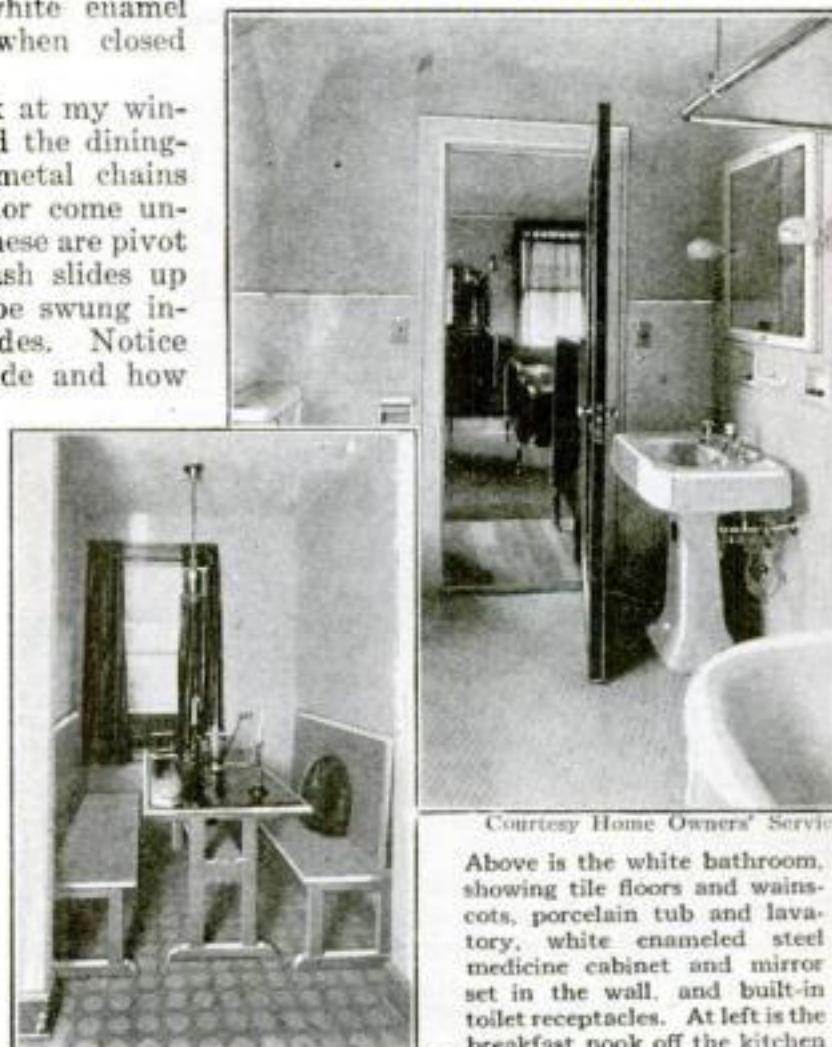
"Your bathrooms are just my idea—all white fixtures," said Marion.

"The best is really the cheapest and most satisfactory in plumbing fixtures," I said. "Tile floors and wainscots are easily kept clean and prevent damage due to splashed water. Rubber is equally good. Tubs fitting exactly into one end of the room with solid bases down to the floor prevent accumulation of unsightly and unsanitary dust under them, while lavatories supported on a standard make cleaning around them easy."

THAT surely appeals to the housewife," agreed Marion.

"Notice now that the bathroom door swings into the bedroom," I pointed out. "See, on the back is a full-length mirror, a substitute for a pier glass without taking up so much room. Now look at this white enameled steel medicine cabinet set into the wall with its mirror door.

(Continued on page 116)



Courtesy Home Owners' Service

Above is the white bathroom, showing tile floors and wainscots, porcelain tub and lavatory, white enameled steel medicine cabinet and mirror set in the wall, and built-in toilet receptacles. At left is the breakfast nook off the kitchen

Two Radio Receivers in One

How to Build a Combination One- and Three-Tube Portable Set

By Joseph Calcaterra

Radio Editor of
POPULAR SCIENCE MONTHLY

AT A recent radio show I overheard a visitor commenting on a so-called "portable" set.

"That set is portable," he said, "if you happen to have three husky fellows handy."

This remark I kept in mind in designing the portable set I shall describe this month—a really portable set, yet one that will give just as good service in the home as it will on a trip.

An unusual feature is the construction of the set in two units. The first is a detector unit; the second a two-stage amplifier unit. These units were made for each other, so that the detector unit can be

good pair of phones attached to a horn. Local stations came in loud and clear.

The symbols on the wiring diagram on this page have been numbered to correspond to the numbers assigned the parts in the photograph of the panel layout.

variable grid leak and fixed condenser. A fixed condenser and fixed leak may be used instead.

Numbers 9, 18, and 19 are the detector, first stage and second stage tube sockets.

Numbers 10 and 28 are the rheostats. Those giving a fine adjustment are to be preferred.

Number 11 is a mica fixed condenser. Its value may vary from .0001 to .001 microfarad.

Number 12 is the positive A and negative B battery post. Number 13 is the negative A battery post and No. 14 is the positive B battery post for the detector stage.

Numbers 15, 22, and 23 are jacks. Terminals A and D are the outside springs. Terminal B connects with the inside spring that makes contact with outside spring A, while terminal C connects with the

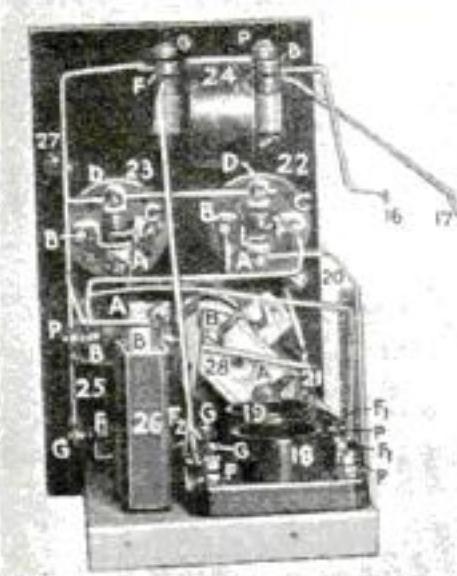
inside spring that makes contact with outside spring D.

The last jack may be a single-circuit jack, but the other two should be double-circuit ones.

Numbers 16 and 17 are the connecting wires from the primary of transformer 24. These wires are connected with the B and C terminals, respectively, of jack 15 when the amplifier unit is to be used with the detector.

NUMBER 20 is the negative A battery, and number 21 is the positive A battery connection. These posts are connected with numbers 13 and 12, respectively, of the detector stage when the amplifier unit is added to the detector.

Number 24 is the first stage transformer and No. 25 the second stage transformer. Small-size audio-frequency transformers should be



Rear view, showing parts lettered and numbered to correspond with wiring diagram

used either alone or in connection with the two-stage amplifier.

The weight of the detector unit alone is 3½ pounds and that of the amplifier unit is 2½ pounds, making a total weight, when both are used together as a single unit, of 5¾ pounds.

SINCE the set is designed for use with the UV-199 and C-299 types of tubes, a 4½-volt C battery can be used as the A battery and a small 45-volt battery as the B battery. The C battery is a miniature 4½-volt flashlight battery.

With complete accessories including phones, aerial equipment, batteries and carrying case, the total weight of the outfit will not exceed 13 pounds, if care is taken to select lightweight parts.

In designing the circuit, I have modified a standard regenerative circuit along lines similar to those in the one-tube set described in the January issue, with which readers of POPULAR SCIENCE MONTHLY have reported exceptional results.

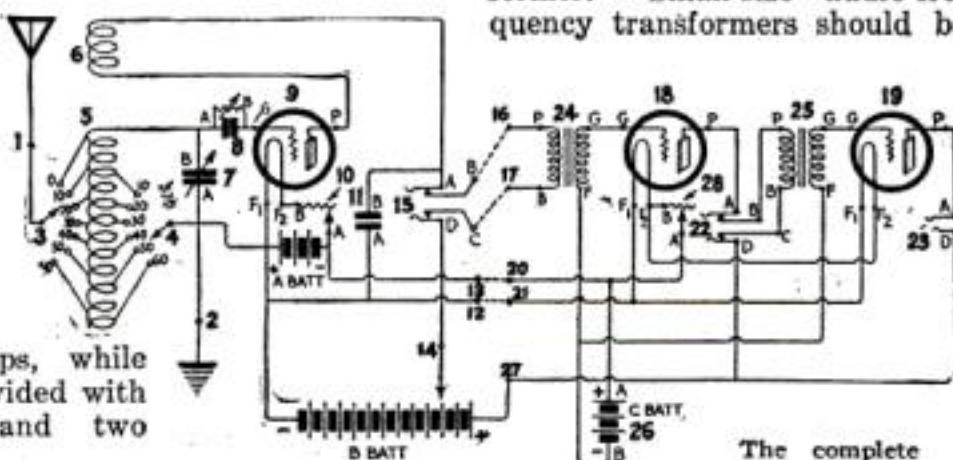
Using only the detector stage of the portable set, Chicago stations (700 miles away) have come in loud enough to be heard clearly throughout my laboratory. The loudspeaker I used consisted of a

Numbers 1 and 2 are the aerial and ground posts respectively. Numbers 3 and 4 are the aerial and ground switches respectively. Switch No. 3 has seven switchpoints and two switchstops, while switch No. 4 is provided with six switchpoints and two switchstops.

Number 5 is the stator winding and No. 6 the rotor winding of a standard or homemade variocoupler. The one used in this instance was homemade, having 60 turns of No. 24 d.s.c. wire tapped at every 10 turns for the stator winding and 40 turns of No. 22 d.s.c. wire for the rotor winding. The stator winding was wound on a four-inch tube and the rotor winding on a 3½-inch rotor.

Number 7 is a .0005 microfarad (from 23- to 25-plate) Vernier variable condenser. The rotary plates terminal is marked A and the stationary plates terminal is marked B.

Number 8 is a well-known type of



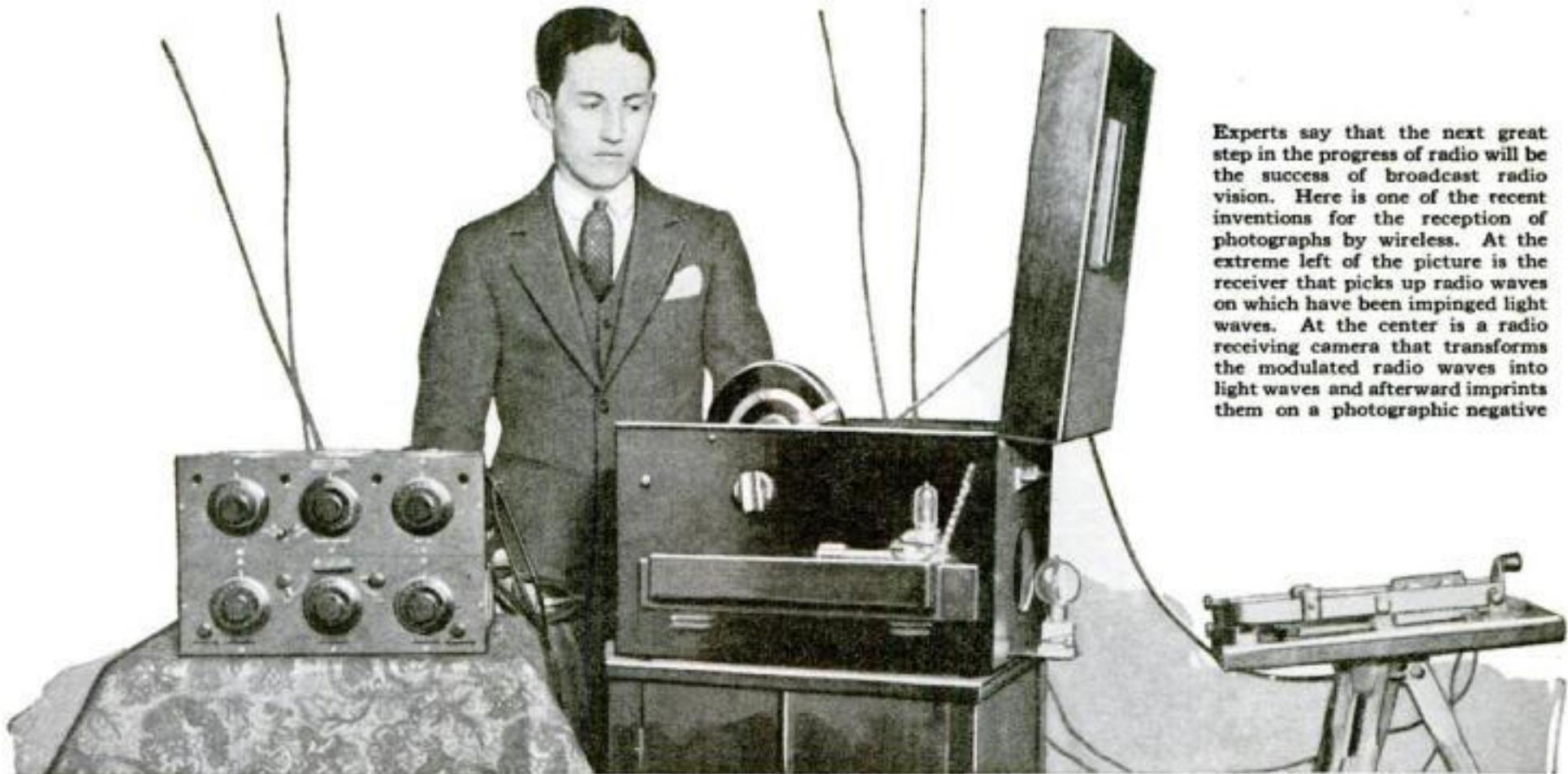
The complete wiring diagram

used to conserve space and to keep the weight of the set down to a minimum.

Number 26 is the 4½-volt flashlight battery that is used as the C battery. Number 27 is the positive B battery post of the amplifier stages.

The panel used for the detector stage is 10 inches long by seven inches wide. That used for the amplifier is four inches long by seven inches wide. The detector unit baseboard is nine inches long by 4½ inches wide, leaving a space of one half inch from each edge of the panel.

The baseboard for the amplifier unit is
(Continued on page 117)



Experts say that the next great step in the progress of radio will be the success of broadcast radio vision. Here is one of the recent inventions for the reception of photographs by wireless. At the extreme left of the picture is the receiver that picks up radio waves on which have been impinged light waves. At the center is a radio receiving camera that transforms the modulated radio waves into light waves and afterward imprints them on a photographic negative.

Setting the Pace in Radio

RE-BROADCASTING undoubtedly is the year's most important development in radio. Re-broadcasting is exactly what its name implies—a second broadcasting by several stations of radio programs transmitted to them from the stations at which the programs take place, thus multiplying greatly the distance through which the programs travel and increasing the number of potential listeners.

Of course, in the case of presidential addresses and other important events, this has been done many times by means of land telephone lines. But through the recent development of an extraordinary short-wave transmission system, the entire process now can be accomplished by radio, and the frequently discussed possibility of one man's addressing the entire world probably soon will be realized.

THE principle upon which radio re-broadcasting depends is quite simple, although the technical difficulties surmounted in its development were tremendous. In re-broadcasting, a program is transmitted on two wave lengths. One is in the broadcasting range of from 250 to 600 meters. These signals can be picked up by ordinary receivers within range. The other is 100 meters or less, which is below the receiving range of ordinary receivers.

The re-broadcasting stations, however, are equipped with receivers capable of picking up the short-wave signals, and, when they are received, they are re-broadcast automatically over a wave length within the broadcasting range.

Re-broadcasting is new, but it is no sudden development. It is the result of years of painstaking work by engineers of the Westinghouse Company under the direction of Frank Conrad.

Thus far most of the work of the experimenters has been done with a non-

By Jack Binns

Beginning with this issue Mr. Binns will keep you in step with the very latest developments in the swift progress of radio, as they occur each month. Every reader who has followed his intensely practical articles in POPULAR SCIENCE MONTHLY knows that he is peculiarly qualified for this service.

Fifteen years ago Jack Binns, then a wireless operator, sent out from the sinking steamship "Republic" the first "CQD" distress call in history, saving 1650 lives in the first wireless rescue at sea. Since then he has kept abreast of radio during its spectacular development, and today he is America's most popular writer on the subject.

directional aerial at station KDKA, Pittsburgh. Now a novel type of aerial is being developed for still greater efficiency in radiating the short waves toward KFKX at Hastings, Neb., the re-broadcasting station, and across the Atlantic to England. Recently the short-wave relay was used in broadcasting a program from station WJZ in New York City. A telephone wire carried the program to station WGY, Schenectady, whence short-wave transmission carried the signals successively to KDKA, to KFKX and to KGO at Oakland, Calif., thus covering virtually the whole country.

The important thing is that the preliminary work has been completed, and the possibilities defined. It will not be long before one broadcasting station can be linked up with all others. Then any speaker can "tell the world" in reality.

Broadcasting on Wheels

ANOTHER kind of broadcast relaying that will supplement readily the one just described has been developed by

engineers of the General Electric Company. This consists of a mobile broadcast plant of low power that is used to pick up programs from remote points and relay them by radio to the main transmitting station.

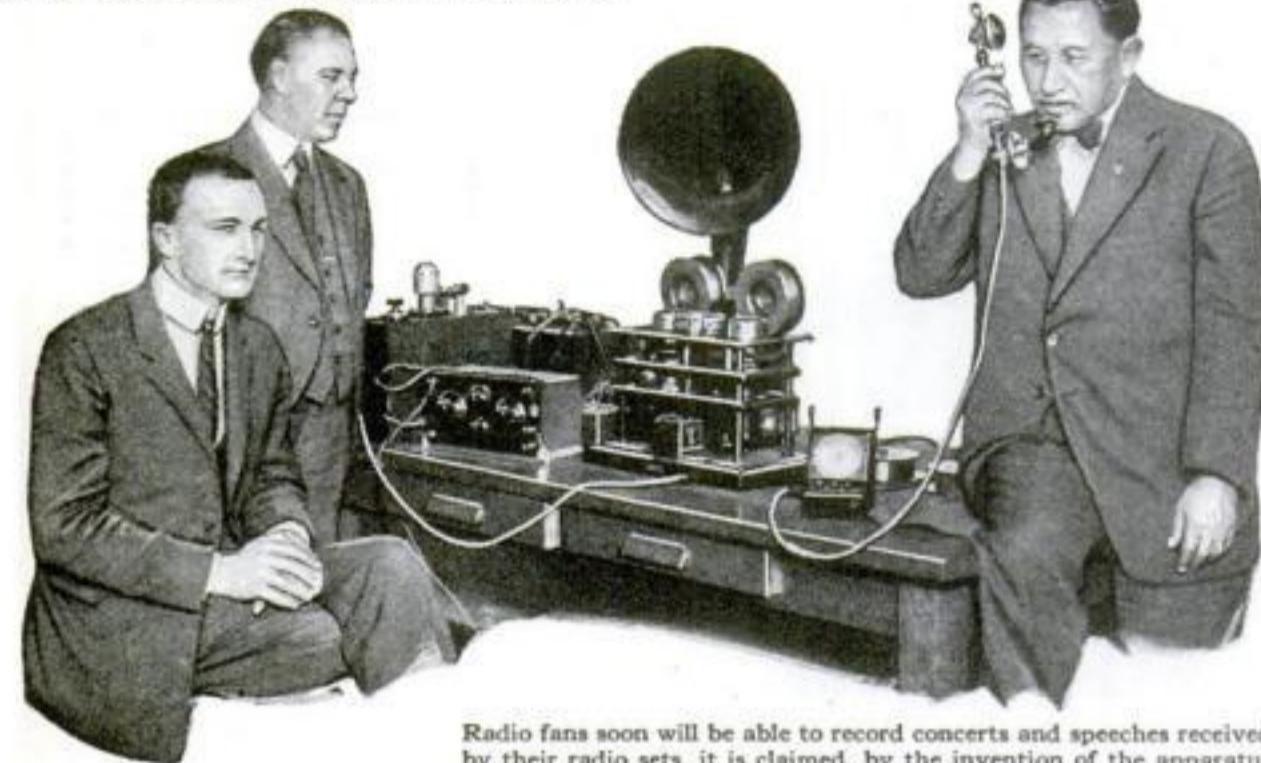
A wave length of about 110 meters is used. This is far below the range of ordinary receiving sets, so that no interference is caused. The small transmitting set is mounted in a covered automobile truck permanently wired for operation. It can be run directly to the place where the program is being given, and put in operation within a few minutes. This is an advantage over the wire connection, since it usually took hours to prepare the latter and test it for quality transmission.



Fire-alarm signals by "wired wireless" have been introduced in London. The radio transmitting apparatus within the alarm box is connected with electric-light wires and with the ground. Pulling the alarm lever rings a bell at the fire station and registers the box from which the signal is sent.

Oversea Phone Service

AN IMPORTANT radio development, which is expected ultimately to give us commercial telephone service with Europe, is the so-called "side band transmission," which is taking place every day between Rocky Point, L. I.,



Radio fans soon will be able to record concerts and speeches received by their radio sets, it is claimed, by the invention of the apparatus shown above, which makes a permanent record on a magnetic wire. Ethnologists of the Smithsonian Institution at Washington, D. C., are seen using the instrument to make a record of a Sioux Indian song

and England on a wave length of 5000 meters.

For more than a year the experimenters have been obtaining transmission and reception data every day, preparatory to the establishment of a regular service. They are using a system that deliberately suppresses the carrier wave. The result is greater efficiency and more selectivity with less power. Telephonic conversation across the Atlantic can be made in daytime by this means with 100 kilowatts.

Radio Surgery

NOw comes the radio knife for surgery!

This latest marvel was used in a Chicago hospital recently in two cancer operations. The "knife" resembles a needle. It is connected electrically with a radio transmitter that produces high-frequency current. It thus becomes one electrode. The other is connected with the patient's body.

Human tissue, of course, offers resistance to electric current, and sufficient heat is generated to cause the "knife" to burn through the skin quickly. The incision is bloodless, for it is cauterized immediately.

A Huge Business

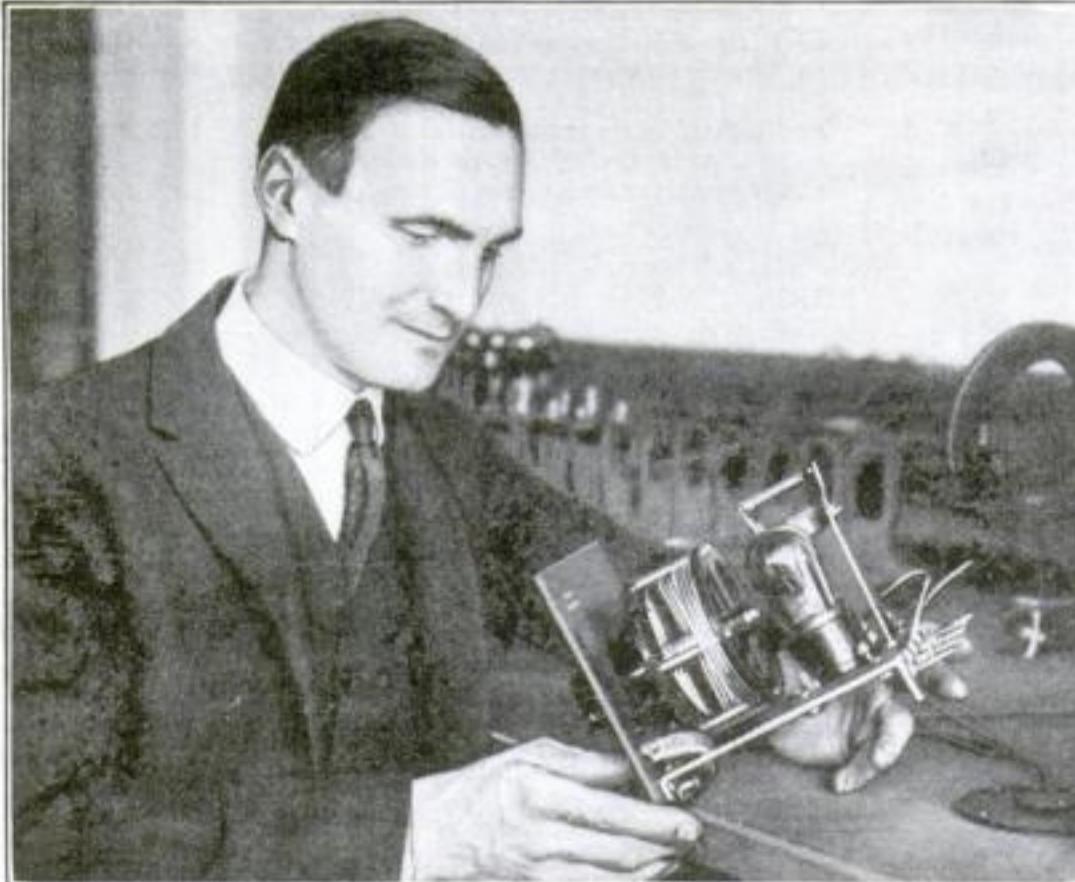
RAdio's grip on the public is almost unbelievable. Two years ago, so far as the public was concerned, radio was

practically unknown. Now it is one of our leading industries. Last year one corporation alone sold \$22,500,000 worth of broadcast receiving apparatus, according to a sworn statement. There is no



doubt but that the others combined sold as much again. Just think of it—a \$45,000,000 business growing up in two years!

Other radio statistics are equally impressive. There are 563 licensed broadcast stations, and upward of 5,000,000 receiving sets. More than 10,000,000 persons listen in every day. More than 250,000 persons are employed in radio work by 3000 manufacturers, 1000 jobbers, and 25,000 retail dealers.



Here is shown Alfred H. Grebe, widely known radio inventor, with his new invention, the "clarifier." Hitched up to any regenerative receiver, its inventor claims, it will absolutely prevent radiation, or "re-radiation" as it is sometimes called, thereby eliminating any chance of causing annoying squeals in other receivers in the neighborhood. Hitched

up to any kind of receiver, it is said to supply its user with stronger signals, improved selectivity, increased quality of signals, and a longer receiving range. The clarifier will work with all types of tubes, can be added to any set without wiring changes, works with either long or short aerials and covers the entire broadcasting wave-length range

An Aid to Cable Service

THROUGH radio will come an era of speed and efficiency never dreamed of in transoceanic communication, in the opinion of Major-General George O. Squier, retired, former chief signal officer of the army.

Not that General Squier is predicting the supplanting of the cable by radio. On the contrary, what he urges is the use of radio apparatus in conjunction with the cable. Through the employment of vacuum tubes, he stated recently, amplification by several stages of the received cable signals could be effected, thus opening a new range of cable efficiency.

Developments in Europe

THE progress of radio abroad proceeds apace, although at a slower gait than in this country. The latest countries to consider the establishment of national broadcasting are Finland and Brazil. Switzerland has given up the idea of erecting a central national station, and instead will build several stations, probably at Lausanne, Geneva, Zurich, and Basel.

The engineers of the British Broadcast Company are attempting to broadcast the song of a nightingale. A microphone and small broadcast station have been secreted in a grove frequented by the birds.

The Radio Party Line

RECENTLY the radio "party line" made its appearance. Dr. A. H. Taylor and L. C. Young, of the Naval Laboratory at Bellevue, Md., have developed a method by which several receivers may be hooked up to the same aerial and function independently, receiving signals on different wave lengths simultaneously, even while the aerial is being used for transmission.

This is made possible by what they call a "coupling tube unit," which is connected between each receiver and the antenna. Details are not yet announced.

"Ringing Up"

ENGINEERS of the American Telephone and Telegraph Company and the Western Electric Company recently developed a method whereby one radio station can call up another by ringing a bell.

The first application of the new system of ringing up by radio undoubtedly will be to commercial wireless work. It would be highly useful, too, in intercommunication in a naval fleet. Some day we all may be ringing a radio bell in our neighbors' homes just as we do by telephone.

Confessions of a Used-Car Gyp

As made to Leslie V. Spencer, M.E.

I USED to be a gyp. At least I had a job for a while with a very successful gyp in a large Eastern city. At the time I took it I didn't realize just what a job it was. It didn't take me long, though, to discover what kind of an establishment I was in, and I got out as soon as I found another job. The things I saw in that place made my hair curl, and I'm telling them now in hope they'll serve as a warning to people who are thinking of buying second-hand cars from dealers they don't know.

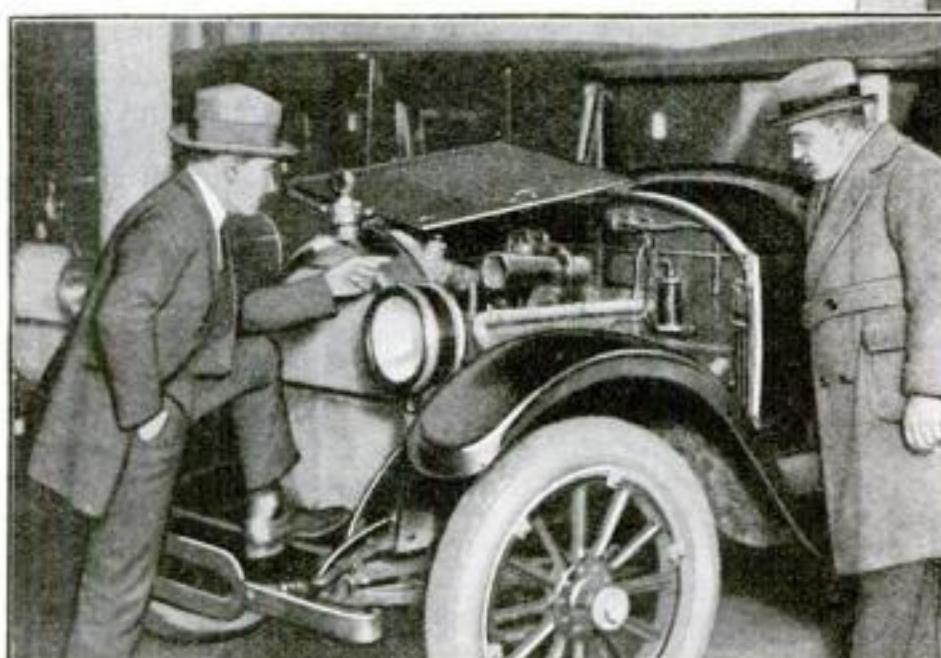
There are two kinds of people in the used-car trade—legitimate dealers and "gyps." The legitimate dealers require no explanation. They trade in used cars just as honest people all over the world trade in other articles of commerce. They're in the business to make money, of course, but they make it honestly by giving their customers value and satisfaction to the best of their ability.

The used-car gyps, though, are entirely

mechanics and painters got through with them, they looked like real bargains—as far as outside appearances went. As to the service they'd give, that was something that Charlie didn't bother about. A lot more time and care were spent on making the cars look right than on mak-



The used-car gyp does just enough work on a car to enable it to run out of his shop. His sole purpose is to turn over a usually worthless article as quickly as possible for as much money as he can get



When the dishonest dealer tries to sell a worn-out car as a practically new model, the engine always is beautifully clean, the body glistens in a brand-new coat of paint, and the tires are painted to look like new

a different class. You'll find the word "gyp" in the dictionary, which says it means a "swindler or cheat." In acquiring and selling used cars the gyp aims to give nobody a square deal. His sole purpose is to turn over a usually worthless article as quickly as possible for the largest possible amount of money. If he can disguise an automobile that's really fit for the junk pile sufficiently to sell it to some unsuspecting person for a thousand dollars, he's put over a "good" deal. That the car stops, never to start again, after going a hundred miles, bothers him not a bit; for the gyp is almost a fanatical believer in the old maxim of law and business—"Let the buyer beware!"

THE boss of the place where I worked was called "Charlie." He had two floors in the automobile district. The ground floor was like any ordinary garage, but upstairs it was quite different. The cars that Charlie and his gang "picked up" were run up to this second floor on an elevator, and, when we

ing them run right. Charlie had learned from experience that if a car had plenty of shiny paint on it, the green buyer was likely to take its performance on faith.

The condition of a car when it came in and where it came from were by no means as important as the

selling end. Once the engine was "doped" with high efficiency gasoline and with heavy oil to silence the rattles so the car would run through a demonstration, and the body was fixed up with paint, advertisements would be run in several of the daily papers. It rarely took more than three or four days to sell a car after it had come from the upstairs shop.

THERE were always cars going in and out, and I learned the history of some of them. For instance, a hard-looking fellow drove in one day with a Packard touring car that was a fairly late model, but pretty badly used up. The mudguards were badly twisted, the windshield was cracked, the metal supports of the top were bent and broken, the top itself badly torn, and the car was covered with mud and dust.

This fellow told Charlie he had "picked up" the car in some Southern state. He was walking along a road, he said, when the car suddenly skidded and

turned over into a ditch. The owner, un-hurt, walked away to look for a farmer to pull out the car. He was scarcely out of sight when a farm wagon drove up from the opposite direction. The man who brought the car to Charlie immediately got an idea. He stopped the farm wagon, told the farmer he owned the car and offered him \$10 if he'd pull it out of the ditch.

A FEW minutes later the car was again on the road, and, while the farmer was hitching up his team, waiting to be handed the \$10 he had been promised, our friend jumped into the driver's seat and drove off.

Charlie didn't bargain with the man. He just opened his safe and handed his visitor \$300. Then he put the car into the elevator.

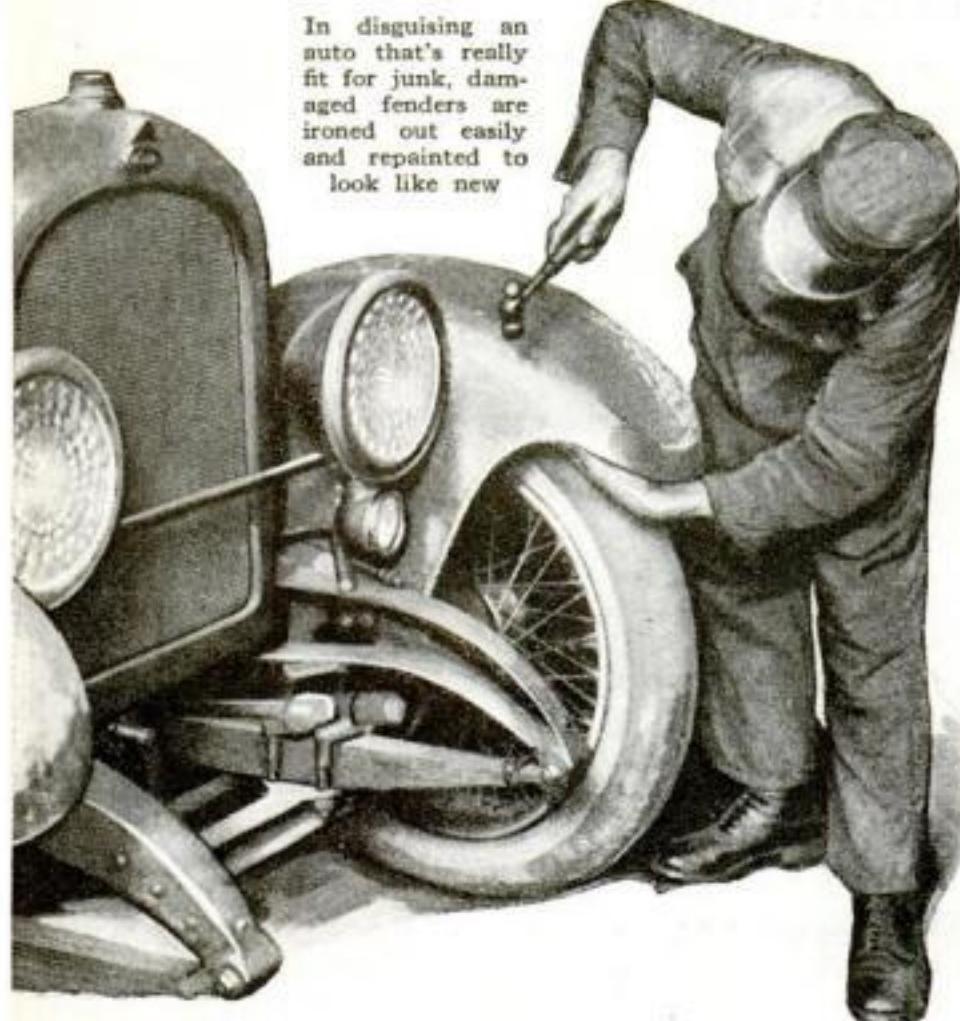
The old bus didn't look so bad after it had been washed. Charlie destroyed the automobile license plates, and then we started to work. We overhauled the engine, got new mudguards and other needed parts from the service station, changed the motor number, put a new glass in the windshield and installed new metal in the top. Then the car was painted, and when the top was folded back so that the tears didn't show, it looked ready for Fifth Avenue.

Meanwhile Charlie had faked a bill of sale that would have convinced a judge that he got the car in an honest deal from a reputable man. A couple of days later anybody who was looking for a bargain in automobiles would have found one advertised in most of the morning papers. And when the "suckers" started to troop in, Charlie himself played the

part of the broker who had lost everything in the stock market and consequently had to sell his handsome car for a song.

THE "song" was \$2000, and, when Charlie found a man who would pay it, he made just about \$1600, for besides the \$300 he had paid for the car it cost him about \$100 to repair it.

Another time one of Charlie's scouts called up on the telephone to say that a Dodge had been virtually demolished by a



street car, and that he could buy the wreck for \$50. Charlie told him to grab it, and within a couple of hours Charlie's wrecking car had hauled in the most hopeless looking mass of junk I ever hope to see. Even after we'd taken off the ruined mudguards, the body, and the two broken front wheels, there didn't seem to be much left but wreck. The frame and the axles were bent, the springs were hanging loose; the thing looked just like what it had been sold for—junk.

We finally got a little encouragement when we found the engine would run after a fashion, although the crankcase and water jacket were cracked and the radiator had some big holes in it. We putted the cracks, straightened the radiator cells, soldered them up and poured a lot of flaxseed in with the water when we filled the radiator. After a while it stopped leaking.

A COAT of gray paint hid the putty on the engine and helped hold it in place. Then we straightened out the frame as well as we could without spending much time on it, put on a brand new body, new front wheels and a set of new mudguards, and filled the gas tank with extra volatile gasoline. The next day the car was advertised in the papers.

Charlie's crack salesman, whose name was Jim, was given the job of disposing of this camouflaged wreck, and in three days he'd done it. He let his victim have it cheap, too—\$800, with insurance thrown in, which represented a profit of \$500 at

least. The buyer was well satisfied apparently, too. How was he to know that that smart new body hid a sprung frame that eventually would make every operating part of the car go bad?

Another car that came in some time later had an engine that sounded like a concrete mixer. As an experienced mechanic, I was for taking the engine down, replacing the loose bearings and worn pistons, grinding the valves and so on. Charlie, though, had a simpler system than that. He merely had us fill up the crankcase with oil that was almost heavy enough for a transmission case! It silenced all the rattles; but I'd hate to drive that car very far away from home!

In another car we found two teeth out of the intermediate gear when we were putting in new grease. Ordinarily that would be serious, but it wasn't to Charlie. He had us shape two pieces of steel to conform as nearly as possible to the shape of the missing teeth—and we screwed them into place! Then

we filled the transmission case with a mixture of oil and sawdust to cushion the meshing teeth and silence the noises. We never heard from the man who bought that car. I'll swear it didn't run very long, but maybe he was the kind who'd rather take his loss than admit he'd been swindled.

Every day you'll see in the papers advertisements that, besides offering a used car at an astonishingly low price, inform you that the car has run "only 500 miles."

NOw, I suppose there are such cars on the market, but my experience in Charlie's place makes me doubt it. For one of the first things we did with a car when it came in was to reduce the mileage by resetting the speedometer. A penknife inserted in the slots between the numbers and a little patience were all that was necessary to turn an old warrior that had gone 50,000 miles into a "very slightly used" car with a



Beware of excessive smoke from the exhaust. It is an indication either of worn cylinders or of heavy oil put in the crankcase for the purpose of disguising engine rattles

speedometer that recorded a scant 500.

Very volatile gas—a high test fuel such as racing drivers sometimes use—is one of the secrets of the snappy motor performances which a gyp dealer's cars give on demonstration. This fuel makes starting easier, and gives more "kick" to the whole performance. Another thing that smart gyps like Charlie always are particular about is that the battery be fully charged. Of course, the battery may be "shot," but they get by that difficulty by overcharging it for the demonstration. When the plates of the battery are so far gone that not even overcharging will make it function, filling it with the acid from a good battery often will make it last long enough to demonstrate the car.

PLATINUM is expensive, and one thing the gyp hates is needless expense. Accordingly, if the platinum points in the timer are badly worn, Charlie and his kind don't bother to replace them with platinum. With a sharp knife they cut little chips from a ten-cent piece, and hammer these into the points. Of course, the silver points don't last, but somebody else has to worry about that.

Often you'll see used cars advertised as having new tires. In this case the gyp tells no untruth, but the tires are of the kind known among the gyp fraternity as "40-mile bolognies." In fact, it's the exceptional "bolognie" that will last 40 miles. However, they look good—especially if given a coat of white paint.

Charlie and Jim both were expert actors, and they'd think up all sorts of ingenious stories to help them sell cars. I've told you how Charlie played the part of a bankrupt broker. That was a favorite rôle for both of them. Other parts they played ranged from that of a struggling young business man, who was selling his car to take his dying wife to Arizona, to that of a wealthy physician who was retiring from practice.

Well, there's a lot more to the used-car game than that, but what I've told you ought to cause the man who starts shopping around for a second-hand automobile to watch his step. If you're going to buy a used car, my advice is to go to a dealer who is known to be reputable or to take along the best mechanic you can hire and believe what he tells you about a car, no matter how shiny the paint, how new the tires, how peppy the motor, and how low the speedometer reading.

ARE you a good driver? How would you act in a sudden emergency? Next month an eminent psychologist will reveal amazing facts about your emotional efficiency as it affects your safety on the road.

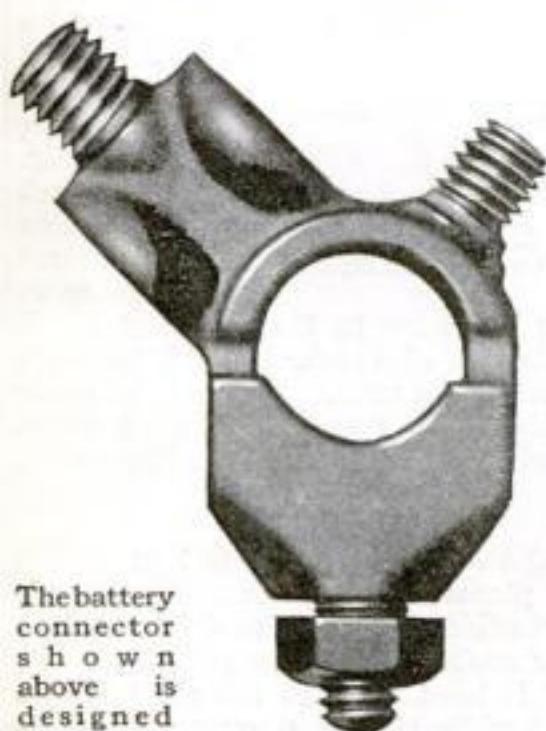
Timely New Ideas for the Motorist



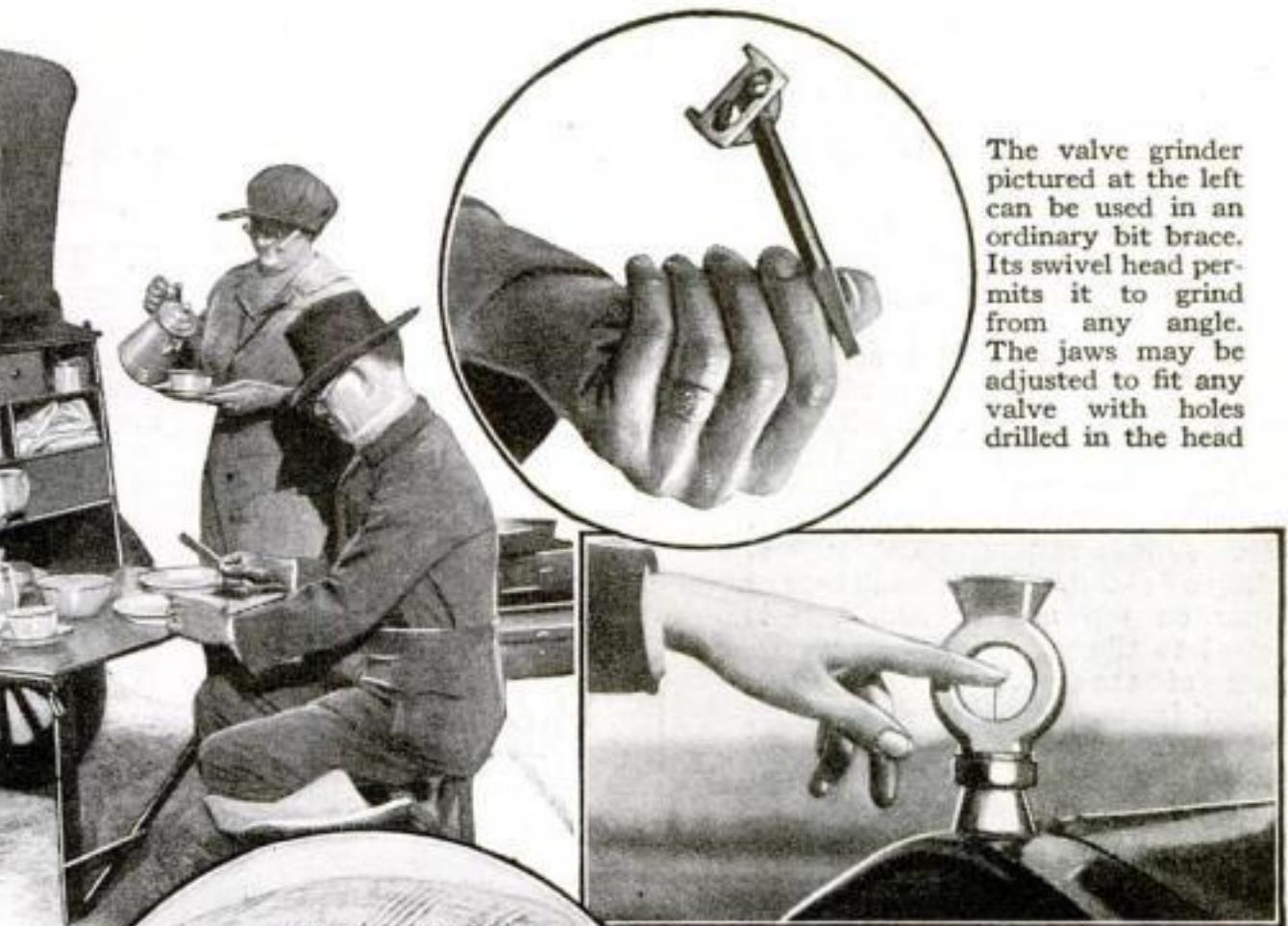
Strapped to a shelf at the back of a Ford car, this water- and dust-proof kitchenette has 13 large compartments, for food, utensils and toilet articles for the motor tour. The door, equipped with folding legs, serves as a table



Air admitted into this globe on the radiator cap is moistened by steam and conveyed to the carburetor



The battery connector shown above is designed for easy removal from any terminal, no matter how corroded. The device is locked in place by tightening the large nut. Loosening the nut frees the grip

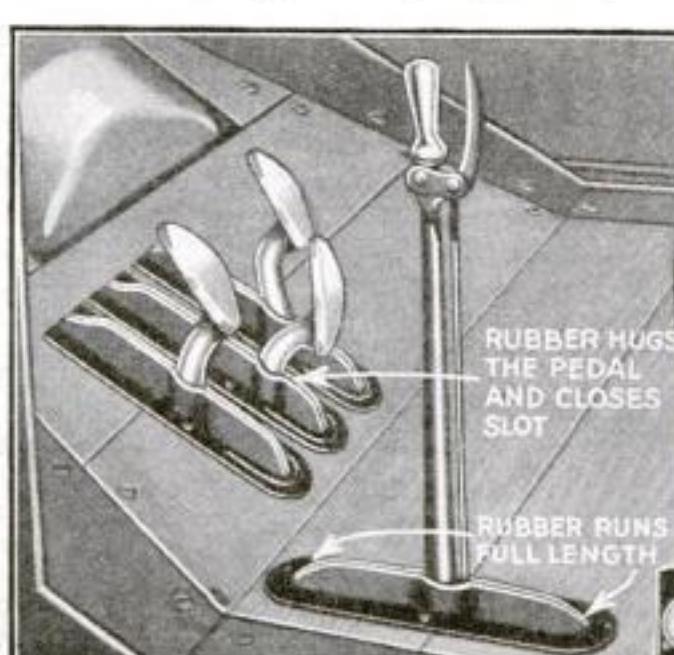


The valve grinder pictured at the left can be used in an ordinary bit brace. Its swivel head permits it to grind from any angle. The jaws may be adjusted to fit any valve with holes drilled in the head

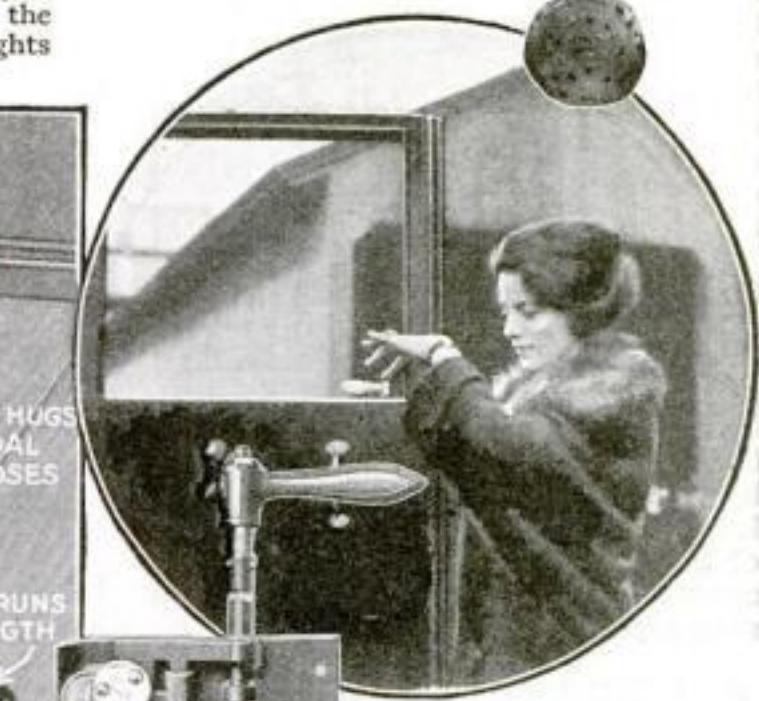
The tiny glass tube within the circle of this radiator cap indicates the water level, while the top opening serves as a funnel for filling



This gasoline gage replaces the regular Ford tank cap. The indicator rod slides through an opening in the cap and has a cork ball at the end



To keep out cold air in winter and hot air in summer, these rubber sheathings for Ford pedal slots have been designed for greater comfort to the driver. They are set in frames bolted to the lower of the two floor boards through which the pedal slots are cut, and hug the pedals closely



The lock mechanism

No key is needed to lock this ingenious new automobile door catch. Pushing down on a button on the inside handle, as shown above, locks the door when it is closed. A special key is required to reopen it

Practical Suggestions for the Auto Owner

A SPOUT that cannot be lost, since it is always attached to the can from which the pouring is to be done, is shown in Fig. 1. Any tubular sheet metal that will fit the cap of the reserve oil or gasoline can is inserted after the end has been expanded slightly to a cone shape and a bead turned up around the pouring cap. After inserting this, the bead is again pressed into shape. The upper end of the tube is flanged slightly to avoid its slipping inside the can.

THE windows of sedans and coupés often develop annoying rattles after the car has been run for some time. A suitable and easily made anti-rattler is shown in Fig. 2. This is simply a small circular piece of rubber about 1 in. in diameter and $\frac{1}{4}$ in. thick. A hole is punched through it slightly off center. With a small burr or washer on top and bottom, this is screwed to the center of the window frame. By turning the disk so that pressure is applied to the glass, rattling is prevented.

FOR lapping cylinders it is possible to use an old, loose-fitting piston for the cylinder block you are working on. Fit a connecting-rod to it in the usual manner and fasten a second connecting-rod to the first, as shown in Fig. 3. A handle of wood or metal through the wristpin bearing in the second connecting-rod is used to rotate the piston.

By smearing the piston with valve-grinding compound and partially working the piston back and forth by twisting the handle and pushing the piston in and out of the block at the same time, a good smooth job can be done as easily as with a more expensive tool.

A GOOD-LOOKING automobile sun visor (Fig. 4) can be made in the home workshop for as little as three dollars. The first step is to make a paper pattern that will serve as a guide for cutting the two brackets from heavy galvanized iron. Satisfactory dimensions are indicated in the accompanying illustration and the best angle usually will be found to be about 20 degrees from the horizontal.



The motorist who looks after small repairs himself saves money

shade is beveled off to fit against the car body. The upper end of one or more of the strips should be screwed, if possible, to the top as an additional brace. Otherwise the ends are cut off flush.

The top of the shade and the brackets are finished with black enamel and the under part is enameled with a smooth, glossy coat of green.

IN GRINDING overhead valves contained in a removable cage, it is sometimes difficult to remove the valve spring pins on account of the light weight and small size of the valve cage assembly. The attachment shown in Fig. 5 will assist in overcoming this difficulty.

WHEN the rim-lugs of a car get worn, they cause much annoyance by the noise they make every time the wheels go round. As it is sometimes impossible to secure new ones at once, a temporary repair may be made as shown in Fig. 6.

Take a strip of heavy tin or sheet iron 5 or 6 in. long and the same width as the rim-lug. Punch a hole in one end the same size as the bolt through the felloe. Lay the strip on the lug so that the hole will come right for the bolt and press the strip so that it will conform to the shape of the lug.

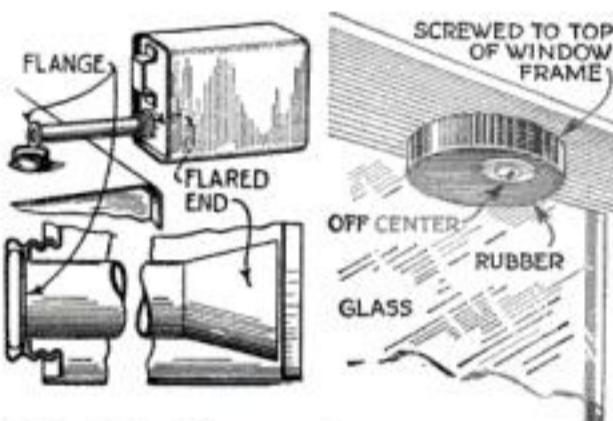


Fig. 1. Collapsible spout Fig. 2. Stopping rattles

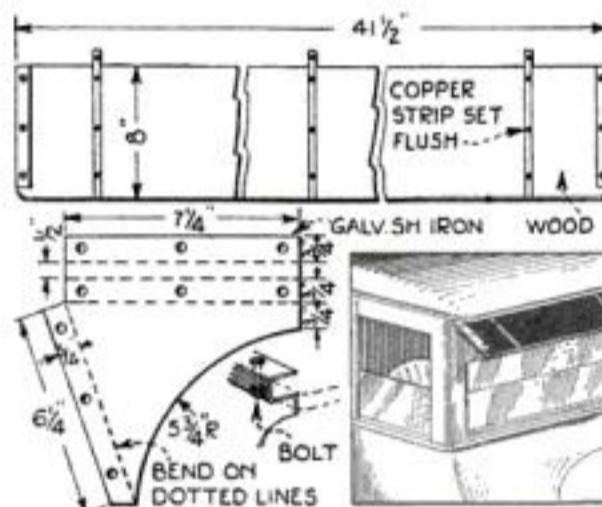


Fig. 5. Simple fixture for removing spring pins

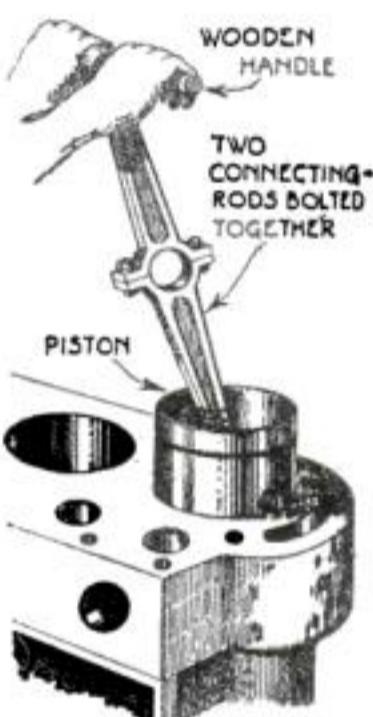


Fig. 3. Old piston makes good lapping-tool

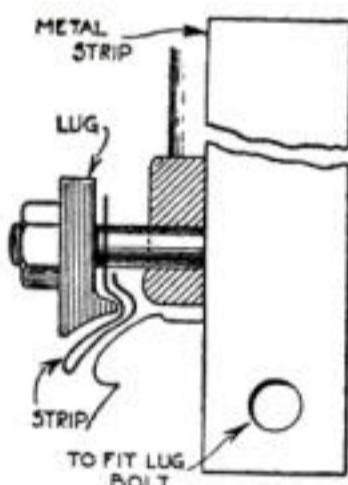


Fig. 6. Tightening ring lugs with tin strips

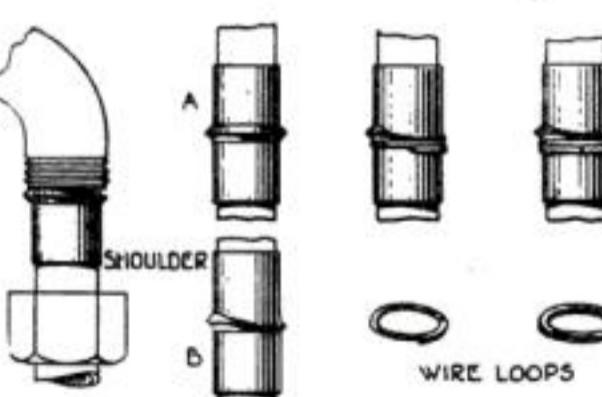


Fig. 4. An enameled board, supported by galvanized iron brackets, forms this neat sun visor

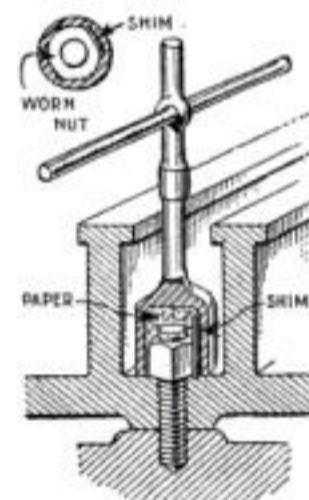


Fig. 8. Crumpled paper holds wrench shim in place

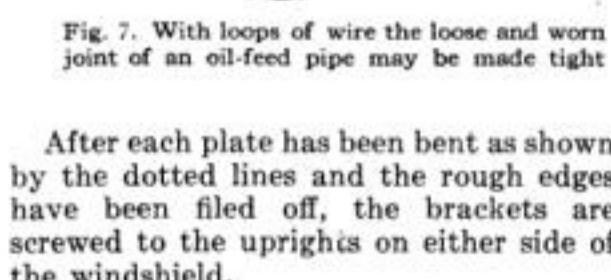


Fig. 7. With loops of wire the loose and worn joint of an oil-feed pipe may be made tight

After each plate has been bent as shown by the dotted lines and the rough edges have been filed off, the brackets are screwed to the uprights on either side of the windshield.

The visor itself may be made of clear cypress or pine. The board is planed down to a thickness of $\frac{3}{8}$ in. and both sides are scraped smooth. It should be cut to length so that it will fit the brackets accurately.

Three or more copper strips are set flush in the upper surface of the shade to prevent warping and the back of the

WHILE examining a friend's automobile, I found he had the upper end of the oil-feed pipe wrapped with tire tape to stop a leak. On uncovering the pipe I noticed that one side of the coupling shoulder (Fig. 7) was almost worn off. The shoulder was originally as in

A, but had worn to the shape of **B**. I ran a loop of wire under it and fastened it by twisting the ends. As this twist made one side higher than the other, I fitted on another loop of wire so as to make it even.

WORN or rusted nuts in inaccessible places are often difficult to remove. It is possible, of course, to shim an open end or socket wrench to pull them off, but it is hard to keep the shim in the wrench while placing it over the nut, as in Fig. 8. This can be accomplished by stuffing a wad of paper in the wrench to hold the shim. The paper is compressed as the wrench is tapped over the nut.

Valuable "Turned" Chair Made by Hand

By Rufus E. Deering

FINDING myself, like many another amateur woodworker, with an ambition to build fine furniture, but with no lathe or even a large assortment of hand tools, I hit upon a method of hand turning that enabled me to make the chair illustrated. The "turning" was done with only a wood rasp, a saw, a bastard file, a $\frac{3}{8}$ -in. chisel, and three or four grades of sandpaper.

The method of shaping the spiral or twisted parts is as follows: The spiral must be marked out on stock that has been rounded with plane, drawknife, rasp or knife. The spirals are laid out by means of a pattern of heavy wrapping paper in the shape of a parallelogram, as in the accompanying diagram. The base of the parallelogram is equal to the circumference of the stock and the altitude equal to the pitch of the spiral to be made. The pattern is wrapped around the stock at one end so that the sides are parallel to each other. It is held in place with thumbtacks while the spiral is marked on the stock between the parallel edges. The pattern then is moved down on the stock and the spiral continued.

After the spiral is marked, a shallow cut is made throughout its length with a saw. The edge of a half-round cabinet rasp is used to enlarge and deepen this cut. When it is about deep enough, the round face of the rasp is used to make the concave curve in the turning. The edges of the depression are smoothed up and the spiral is worked into shape as correctly as possible.

Then the smoothing is carried further

by wrapping pieces of coarse sandpaper around flat or round pieces of wood and using the abrasive as a tool. The final smoothing is done by holding small pieces of fine sandpaper in the palm of one hand and rotating the spindle with the other.

The hexagonal and other parts of the chair are worked in shape with a rasp and half-round wood file and then sanded.

The chair is best made of walnut or similar dark hard wood. I cut the

be shaped, however, by steaming and bending straight stock or by cutting the pieces to shape out of solid or glued-up stock of sufficient size.

Stock $1\frac{1}{4}$ in. square is used for the turnings of the chair, and the parts to be made into spirals are worked down into a round shape $1\frac{1}{4}$ in. in diameter. A pitch of $1\frac{1}{2}$ in. is satisfactory in making the twists. The pieces for the seat are from stock $1\frac{1}{4}$ in. thick, and for the back from 1 in. thick. All joints are glued.

The back and seats are of woven cane. Cane comes in hanks of about 500 ft., which is sufficient to cane two chairs like this. The cane is woven through $\frac{1}{8}$ - or $3/16$ -in. holes drilled $\frac{3}{4}$ in. apart. The cane should be wet before attempting to weave it. The process of caning, while it may seem complicated at first glance, is really quite simple. Even if one has had no experience in caning, a study of a caned chair will show how it goes. Indeed, it costs little to have the caning done, if the home worker does not wish to spend his time on what is a relatively monotonous task.

The chair may be finished any way the builder prefers, but for this style varnish is not really appropriate. It is better finished with two coats of shellac, well rubbed with very fine sandpaper or pumice-stone and oil, followed by furniture wax.

ARTICLES scheduled for early publication tell how to construct a Welsh dresser, a toy giraffe that can

be ridden, a folding ironing-board and cupboard, a combination bookrack, a baby's bath table, improved Chinese game racks, and a toolkit that saves time in keeping the home shipshape.

Handmade walnut chair and details showing the construction and method of laying out the spiral turnings accurately



pieces for the chair illustrated from some walnut tree limbs. There was one advantage in this—the back and legs of the chair were cut from limbs with just enough bend to give them their shape. These may

Balloon-Vender Kite Is a Colorful and Amusing Novelty

By Charles M. Miller

This is the first of two articles by the foremost kite authority in the United States, and the author of "Kitecraft and Kite Tournaments"



spine should stand to the front of the kite, as it is much stronger so placed.

Cut a notch in the bottom of the spine to receive the bow string, which should be drawn fairly tight. Measure the two side strings, and if not equal, slip the string through the notch. When equal, wrap the spine end with string and brush on some shellac. Next lash a 3-ft. stick about $\frac{3}{4}$ in. by $\frac{3}{8}$ in. thick to the spine where the bowstring crosses and to the bow, as illustrated on page 109, curving the stick up a trifle at each end.

The tops of the upper balloons are the only ones that need an extra framework. Number 6 reed used for reed furniture is satisfactory for these rounded forms, as it is very light. Split bamboo is much stronger, but is harder to prepare. The reed can be used dry or wet. The bamboo

(Continued on page 109)

How to Fix a Balky Electric Fan

IF YOU have an electric fan that will not run or is erratic in its behavior, ten chances to one you can fix it with little difficulty and no expense. Most fan troubles, indeed, are easily remedied. What you need to know is where and how to look for them. At that, it is child's play compared to hunting trouble in a radio set.

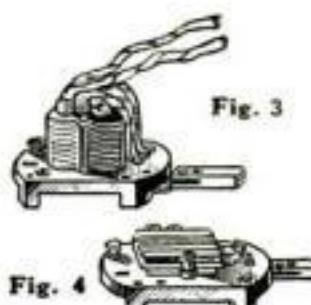
Rugged and well built as is the modern fan, it needs to be cleaned and oiled at the beginning of each season and treated with reasonable care. A bad fall or a dry bearing, a weak brush spring or a badly kinked cord may put the best of fans out of commission.

You can diagnose fan troubles roughly by consulting the chart at the bottom of this page.

Often the difficulty is not in the motor itself, but in the plug or cord. The first thing to do, then, is to try a lamp in the socket to see if the "juice" is there.

The next step is to guard against accidentally blowing a fuse or doing other damage. To do this, open the main service switchboard in the house, note which wire runs to the water pipe or "ground" and then remove the fuse plug from the other side of the line. In this insert the plug of an electric iron or a toaster or a very large lamp, such as one drawing 200 watts. Should neither line be grounded, the resistance can be placed indifferently in either.

Now plug in the fan and place a length of wire across the main terminals in the base. If there is a vivid sparking, the cord is all right. If not, there may be a hidden break in the cord, which usually can be found by bending the cord in various ways, as the spot will get hot. By looking inside the plug, you can tell whether the connections have loosened or the ends of the wires are touching each other; either defect can be remedied

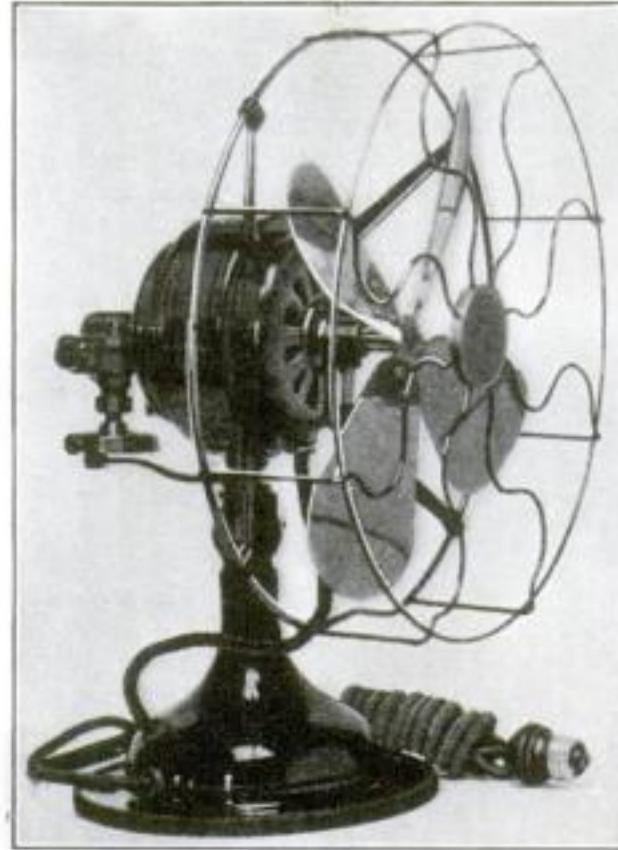


Fan Troubles at a Glance and Their Cure

Trouble	Probable Reasons	How to Repair
Will not run at all	Open circuit	Use test lamp in step-by-step check up of circuit, beginning with cord and resister or starting switch. Reconnect when break is found
Blows fuse	Short circuit	Put resistance in line and examine plug, cord, and connections, replacing or insulating part in which "short" is detected
Sticks	Dirty or bent parts	Clean thoroughly, removing end bell, if necessary; straighten parts and line up bearings; grease well
Buzzes only	Centrifugal fingers bind; burned or dirty commutator; defective brushes; open circuit in armature winding	Check up each possible cause and correct by cleaning, replacing defective parts or reconnecting open circuit
Runs jerkily	Brush does not touch commutator; loose connection; open circuit in armature	Look for sparks, which usually reveal point of failure. Reconnect or replace defective part

easily. Cut off several inches of cord, if necessary, and reconnect the plug, or substitute a new cord throughout.

Once you are sure the "juice" is actually reaching the fan terminals and the fan still won't run,



If the trouble seems to be merely that the fan binds, lint and dirt may have accumulated around the bearings and need to be removed. If the armature or rotor sticks, the bearings sometimes can be re-aligned by tapping their housings gently with a block of wood. This trouble is not apt to occur unless the fan has been dropped. If the bearings are badly worn and the spindle has too much play, the small bushings in each bearing can be removed and new ones inserted.

Now that there is nothing to prevent the fan from turning easily, and the "juice" is being delivered to the motor terminals, it is obvious that there must be something wrong in the wiring itself, if the fan still shows no sign of life. The difficulty is to find just where the short circuit, open circuit, or other defect is located.

First test the starting or speed regulating device, which may be a speed-regulating coil (Fig. 3) or a rheostat (Fig. 4), with switchpoints. The easiest way is to use the electric current itself to ferret out the trouble. To do this, connect to a plug two insulated wires with their ends bared (Fig. 5). One of these wires should be cut and a 15- or 25-watt lamp inserted to act as an indicator. The electric iron or other large resistance used to protect the main house circuit should be removed while this testing circuit is in use. Test the various terminals by touching two of them at a time with the bare wire points. If the lamp lights, the circuit is all right between the points being tested. If it doesn't light, it is a simple matter to narrow down the hunt to the point where the break has occurred.

If the speed regulating coil or coils are all right, the difficulty is in the motor

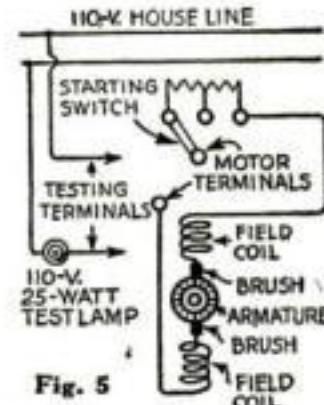
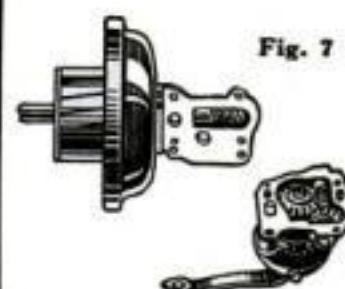


Fig. 6



itself. The wire in the windings rarely breaks, so that the open circuit will be found almost certainly at soldered connections or loose ends.

Examine all con-

(Continued on

page 100)

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- No. 126 Light Oak
- No. 124 Golden Oak
- No. 110 Bog Oak
- No. 131 Walnut



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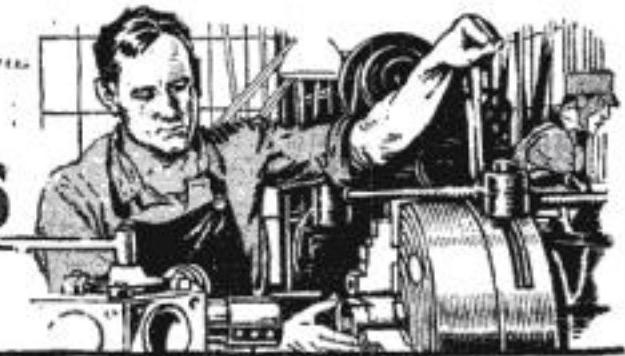
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Better Shop Methods

How Expert Mechanics Save Time and Labor



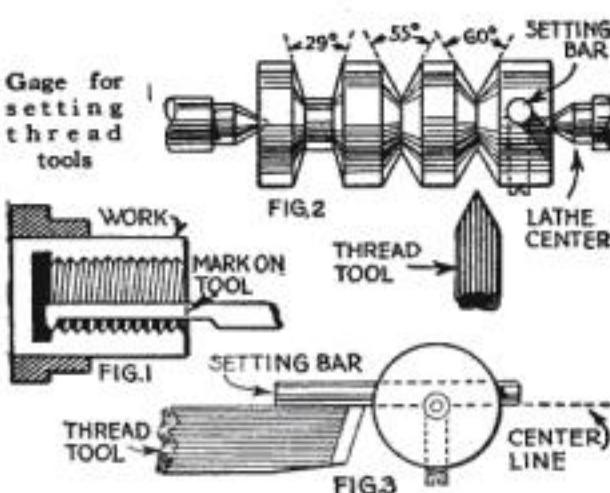
Secrets of Cutting Threads Successfully

By H. L. Wheeler
and Henry S. Laraby

JOE was having a hard struggle with a simple threading job. Several times he had broken his threading tool, and he was trying to reset it when Old Bill came over to see if the job was finished.

With some signs of nervousness, Joe started the lathe again. Perhaps if Old Bill hadn't happened along at this very moment, things might have gone better, but some men do get a sort of sinking sensation when the boss comes along, especially if they are bungling their work. This is what Joe was doing with his threading, for the tool had crossed the thread.

Old Bill was far from pleased, because he had promised the job by noon. To tell the truth, he had been tempted more than once to let Joe go, but he had a kindly feeling toward the young mechanic. He understood, with the tolerance and broad vision of a man who was genuinely a master of shop practice, that mechanical



ability cannot be gained overnight; therefore, he was always willing to straighten out the work of any machinist who showed the least interest in learning better methods.

This particular job was a trifle out of the usual run. Old Bill, considering his promise of immediate delivery, decided to salvage the piece. He told Joe to take it to the smith shop and have the welder stick some metal on the spot where the thread was damaged.

"Get back here just as quickly as you can and dress it down to size," he added; "then come and tell me when you have it ready and I'll show you a few kinks about thread cutting."

After Joe had the job all set again, he went for Old Bill, who took hold of the lathe.



"Just stand by and watch what I do and how I do it," Bill said, as he put over the compound rest at an angle of 30 degrees and set the tool square and on center. His next move was to engage the nut and run the tool along to about the middle of the thread.

"This takes up the back lash," he explained to Joe.

BY MANIPULATING the cross-feed and the compound rest, he soon had the tool perfectly meshed in the old track. He tore a sheet of white paper from his notebook and held it under the tool.

"Look down at the top of the tool, Joe. Do you see any white through the sides of the tool?"

Of course Joe did not.

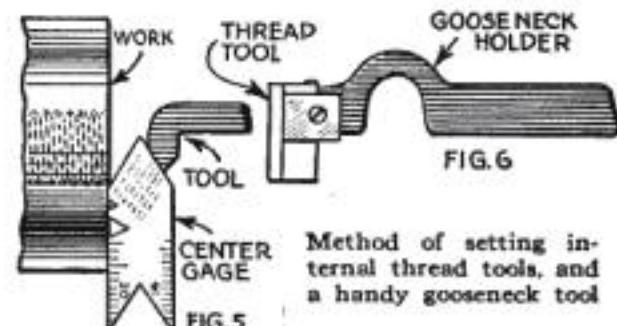
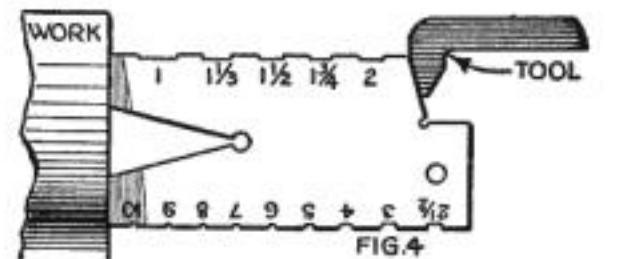
"You see," Old Bill went on, "the point of the tool is now at the bottom of the cut. We'll set the stop at this point, and we are ready for business."

Bill backed the tool out and reversed the carriage to the starting point by disengaging the nut and running it back with the hand feed. He put a chalk mark on the faceplate near the edge of the way and one on the way itself, close to the

carriage. Then he ran the cross-feed into the stop and moved the tool in .003 in. with the compound.

The lathe was started and Bill smeared the thread with oil. The tool peeled off a nice smooth chip as it ran to the end. Here Old Bill pulled the tool out quickly with the cross-feed handle and stopped the lathe, at the same time throwing the nut out again. He turned the spindle by hand until the chalk mark came around to the right position and ran the carriage back to the other chalk mark. He took another cut in the same way and then stood aside to let Joe take hold of the job again.

"You will notice, Joe, that there is no burr on top of the thread and the cut is quite smooth," Old Bill remarked. "That is due to the fact that the tool cuts only on one side and is ground with a slight slope toward the back. I guess you're on the right track now. Next time be a



Method of setting internal thread tools, and a handy gooseneck tool

little more careful. That oil you are using is quite thick. You'd better thin it out with some kerosene and you'll get better results."

With this, Old Bill left Joe to finish the job.

After all, thread cutting is a straightforward operation when a few simple rules are known and observed, but some mechanics tackle a threading job in the fear that they will not be successful. This fear was Joe's principle trouble. The first thing to do is to gain confidence and master a few simple rules.

The explanation of Old Bill's method for catching a thread is this: By having the work and the screw in the same relative position with the starting point of the tool, the nut may be disengaged at the end of each cut and run.

(Continued on page 88)

Old Bill Says—

DID you oil your lathe this morning?

Oil costs money, so see that every drop is put in the right place.

Talking about oil—a little on one's manners helps a lot. Courtesy smooths the day's work.

Be sure of your set-up before you start to cut. The fast worker knows when to take time.

The shop pest is he who is always borrowing tools. Buy your own and be independent.

To do unnecessary work in a shop is a waste. It pays to find the easiest way.

If surface plates could talk, many a one would say, "I am an anvil!"





Hot off the Press

THE NEW STARRETT CATALOG

N^o. 23W is now ready for distribution. Shows all the new Starrett Tools which have been added since our last catalog was published, many of which are here listed for the first time. Get your copy at any Hardware Store selling Starrett Tools or write us.

for instance

Angle Gage
Hold Downs
Extension V Base for
Jack Screws
Rolling Mill Gage
Drill Point Gage
Flexible Stainless Rule
Cylinder Gage
Pocket Micrometer Case
Dial Bench Gage
and some fifty others



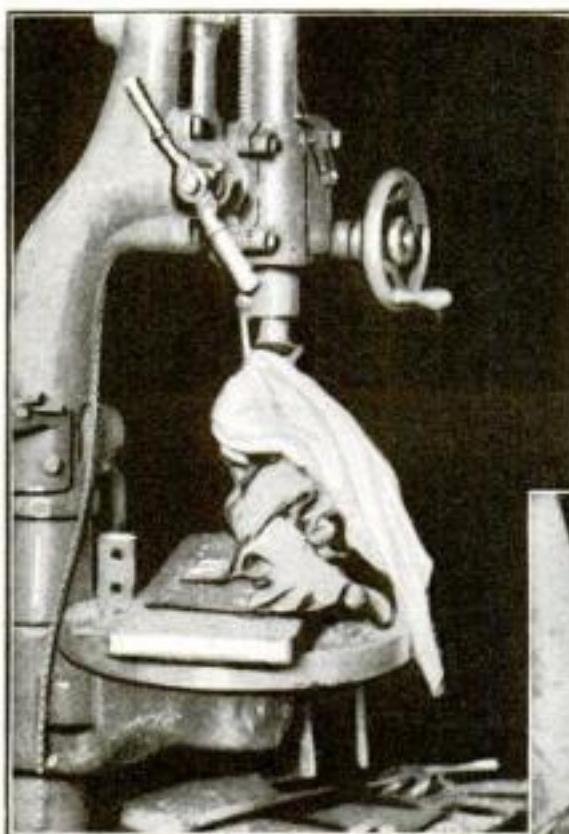
THE L. S. STARRETT CO.

The World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
ATHOL, MASS.



Starrett Tools

Cutting Down Shop Casualties



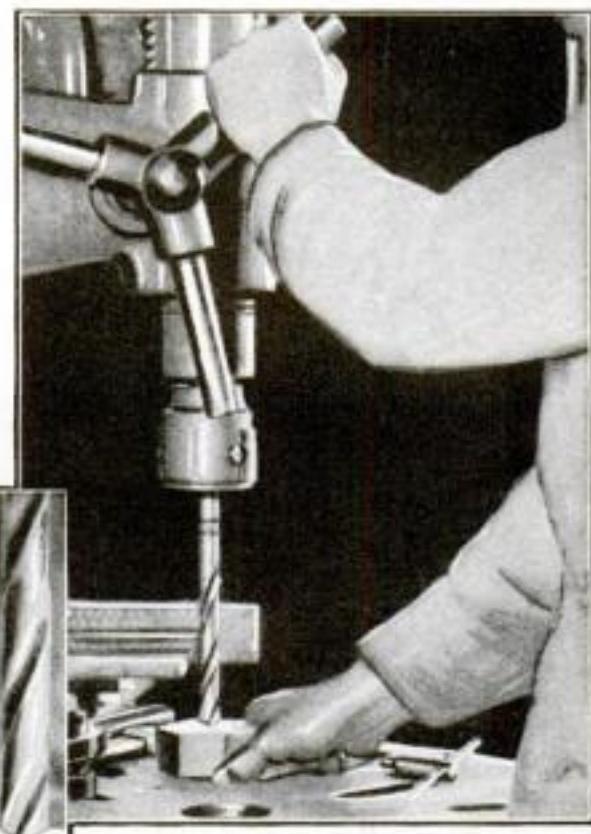
The price of a moment's carelessness. The operator allowed his glove to catch between the work and the drill, and his hand was badly crushed. At the same time the drill literally ripped the clothing off his body. This shows what a relatively harmless machine can do and is a warning of the necessity for continual caution and proper working clothes. To wear loose overalls and baggy sleeves around a machine is to invite mutilation.

EVERY year, according to statistics based on Department of Labor reports and other official sources, 22,000 American workmen die as a result of industrial accidents. This is 45 per cent of the total number of Americans killed in the World War.

Every year, it is estimated, there are not less than 8,400,000 accidents in shops, factories, and similar industrial enterprises, and as a result 680,000 men are laid up for four weeks or more.

Most of these accidents, experts say, are preventable.

Think! Be careful! Go slow!
SAFETY FIRST!



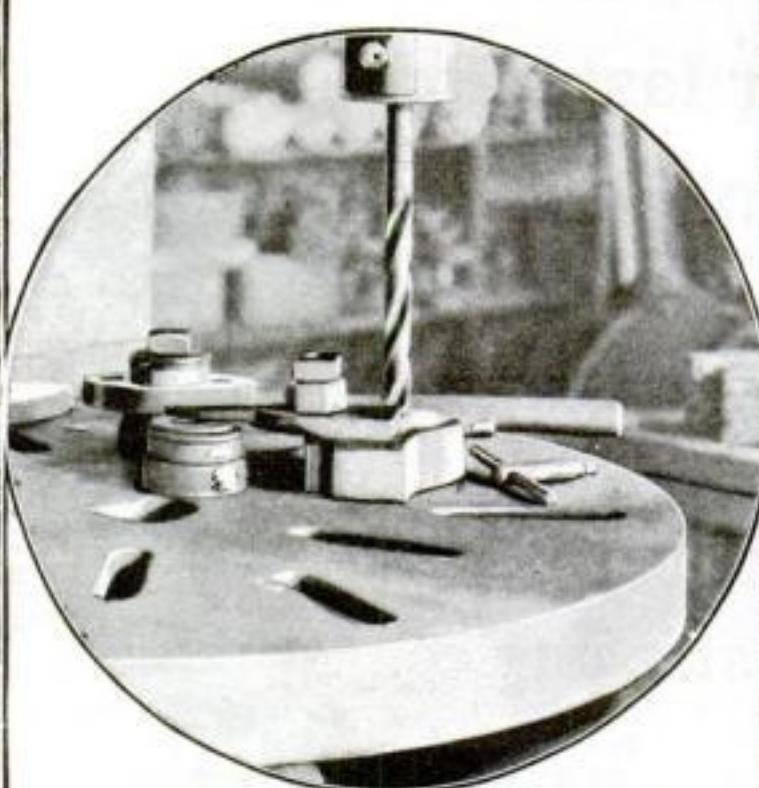
Never try to hold work against a machine's strength, as shown above. A result very apt to follow such carelessness is indicated in the illustration at the left



This workmen's thumb was crushed in a slot of the drill press table when the block he was drilling started to turn. He held the work by hand as in the upper right-hand illustration instead of clamping it



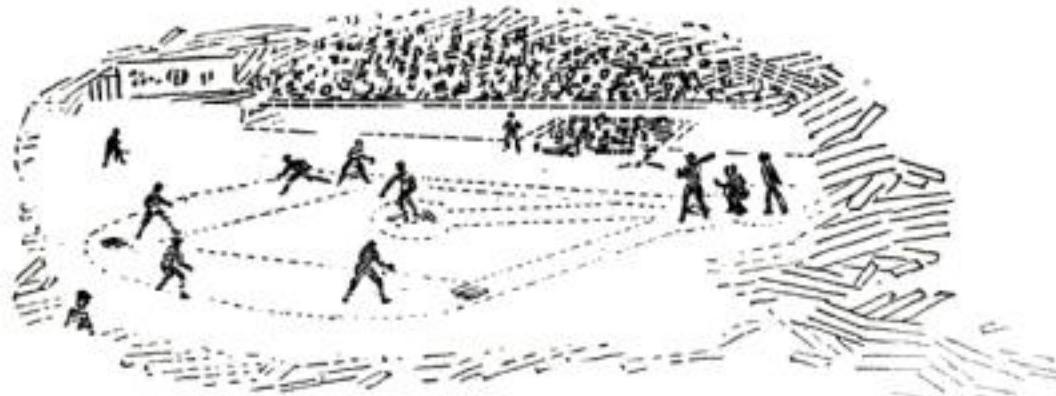
The handles on these lifting hooks are an excellent safety measure, but often overlooked in plants where heavy materials are handled. The workman can adjust one of these hooks and hold it until the crane has started to lift without danger to his fingers.



If the work is properly clamped on a drill press table, there is not much likelihood of accidents like those shown above. By analyzing 350,000 industrial accidents, the National Bureau of Casualty and Surety Underwriters for the National Council on Compensation Insurance, has shown that most accidents occur at the point of operation, or where tool and work meet.



Beware of falling tools. Left in unsafe places, tools may injure a person below



Enjoy Your Radio This Summer

MUSIC MASTER with its rich, clear tone—unmarred by muffling, blast or distortion—will make radio a pleasure such as you have never known before.

Summer opens a new world to good radio sets equipped with Music Master. Picnics, camping trips, boating parties, open-air dances—these are only a few of the occasions which Music Master can enliven for you.

Music Master is remarkably well fitted for summer conditions. The extremely sensitive precision instrument in the base, the scientifically tapered tone chamber, and the now famous wood horn, the natural and perfect resonator—make up an instrument of balanced proportions and unsurpassed effectiveness.

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14-inch Model, for the
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Connect MUSIC MASTER in place of head-
phones. No batteries required.
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"Here's
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lifetime
of using
them!"

"and you
younger fellows
can take it or leave
it, just as you choose"

"I would as soon go to work without my right hand as without my NICHOLSON Files. Through the forty years I've been in this shop, NICHOLSON Files have always been right on the job for me... perfectly tempered, keen cutting and true as dies in their uniformity.

"Yes, I've used them on both heavy work and for fine filing and found that the NICHOLSON File for any purpose is the best file for that purpose.

Most first-class Hardware Dealers carry complete stocks of NICHOLSON Files.

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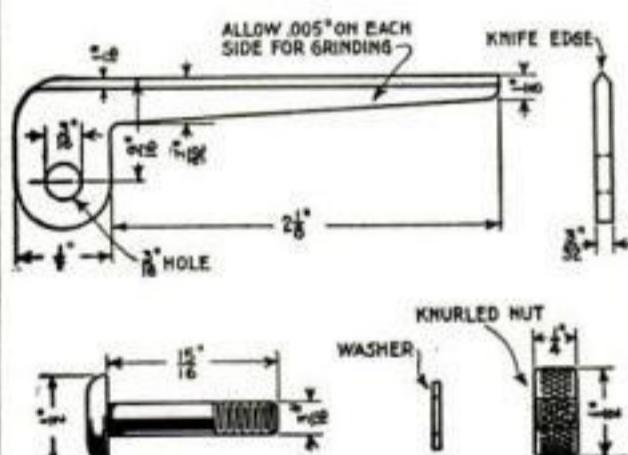
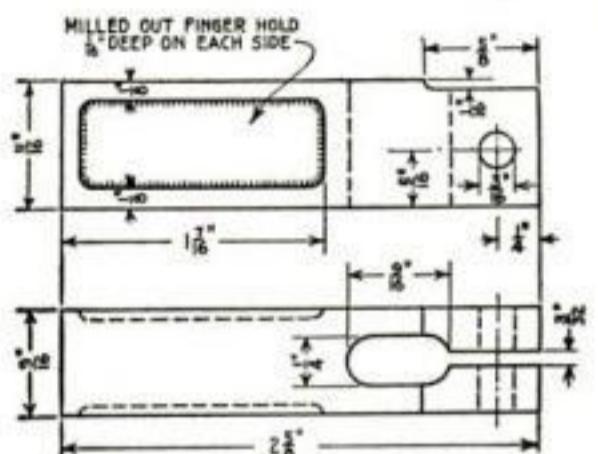
NICHOLSON FILES

~a File for Every Purpose



This Die-Maker's Square Has Sight-Hole in Handle

THIS die-maker's square has been designed so that high spots in the sides of holes can be checked readily by looking along the blade, which cannot be done easily with the usual square. The edge of the blade is made in the shape of a

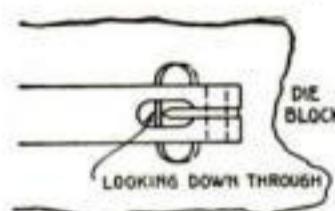


Details of the die-maker's square. Note hole through handle and shape of blade

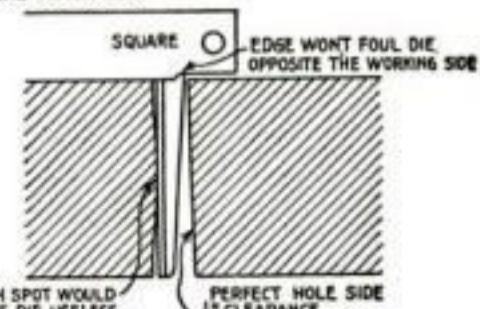
knife edge and is visible through a hole in the handle.

The bottom side of the beam is cut so that it will not catch on the opposite side of the die when used in narrow openings, and the bolt is made exceedingly heavy to prevent the blade from shifting.

While this tool has been in use in certain shops for a number of years, it is not



BY HOLDING WORK TO THE LIGHT AND LOOKING THROUGH THE BEAM HOLE THE HIGH SPOTS ALONG THE BLADE KNIFE EDGE ARE DETECTED.



THIS HIGH SPOT WOULD MAKE THE DIE USELESS
PERFECT HOLE SIDE
.005" CLEARANCE

Accuracy of holes is checked by sighting the blade through the hole in the handle

as well known as it deserves to be among mechanics who handle very fine, accurate work.—H. L.

BRASS may be colored an antique green with a solution of 3 oz. crystallized chloride of iron, 1 lb. ammonium chloride, 8 oz. verdigris, 10 oz. common salt, 4 oz. potassium bitartrate, and 1 gal. water.

V-Block Tool for Centering Round Stock Quickly

A SIMPLE centering tool for centering round stock can be made from a piece of sheet steel about $\frac{3}{16}$ in. thick. It is used in connection with a V block. The tool has four accurate edges, two of which serve as guides in the V block and made to the same angular dimensions. The vertical edge bisects the face angle and intersects the apex of the V.

To use the tool, hold it against the end of the stock while resting in the V block, as shown in the accompanying illustration. Mark along the vertical edge with a scriber and rotate the stock about one quarter turn. Another mark then is drawn along the vertical edge bisecting the first. The intersection of the two lines will indicate the center of the piece.

In addition to its use as a centering tool, this device may be employed as a small square. To allow this, the vertical and horizontal edges should be at an exact right angle to each other.—G. A.

Protecting Small Levels

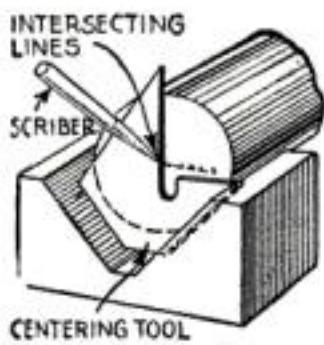
IN LINING up small machines I make use of a 3-in. pocket level. Each week one or more of these levels was accidentally broken until I hit upon the idea of covering the level with rubber, as shown.

To do this dissolve 4 or 5 oz. of crude rubber, preferably what is known as washed para sheet, in 12 oz. of benzol. This will require at least 24 hours. Place the level on a board and apply as heavy a coat as possible by pouring and brushing. When the coat is thoroughly dry, apply another coat and continue until all the cement has been used up. Tie a cord around the level and drop it into a solution consisting of 96 parts carbon tetrachloride and 4 parts of sulphur chloride for about 20 seconds. This immersion effects a vulcanization of the rubber.

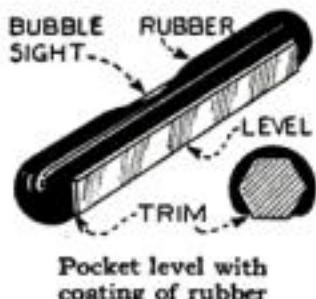
Rinse the level in water and when it is dry, strip away the rubber from the edge side and with a razor blade cut an elliptical opening over the glass sight.—L. W.

Hook for Hot Soda Tank

A HANDY dipping hook for the hot soda tank may be made from a length of $\frac{3}{8}$ -in. cold rolled steel. It will be found convenient for handling small parts having a central hole, for cleaning greasy milling cutters, and for similar work.—H. W.



The centering tool



Pocket level with coating of rubber



This test is
FREE

How Men Win

A significant Shaving Cream story

By V. K. Cassady, Chief Chemist

GENTLEMEN:

Here for 60 years we have studied soap. Some of the greatest soaps in existence are of our creation. Our Palmolive Soap is the leading toilet soap of the world.

Our problem was to create a Shaving Cream so superior that every man who tried it would adopt it.

We brought to our laboratory every other shaving cream. We put them all to scientific tests. Then we studied to excel them in every quality desired.

We made 130 shaving creams, each better than the others. And we at last arrived at what we deem the utmost in a shaving cream.

Millions of men have adopted it. Tens of millions more will when they know.

Just watch it act

Don't buy it—just ask for a ten-shave test. Compare Palmolive Shaving Cream with the soap you are using now.

If we have done what you desire, adopt it. If not, return to the old. We ask no favors.

But we do ask the courtesy of a test. Concede us that test. You owe it to yourself and to us.

5 BETTER RESULTS

It multiplies itself in lather 250 times, so one-half gram suffices for a shave.

It acts in one minute. Within that time the beard absorbs 15 per cent of water.

It maintains its creamy full-

ness for 10 minutes on the face.

The super-strong bubbles support the hairs for cutting. That's the major purpose in a shaving soap.

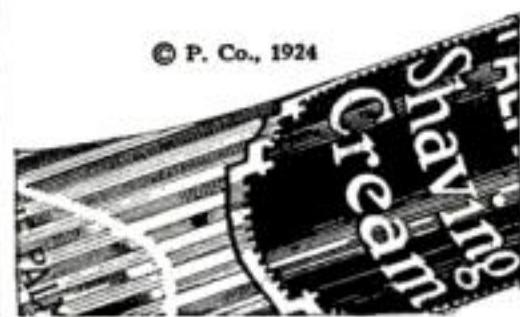
The palm and olive oil blend leaves delightful after effects.

To add the final touch to shaving luxury, we have created Palmolive After Shaving Talc—especially for men. Doesn't show. Leaves the skin smooth and fresh, and gives that well-groomed look.

The Palmolive Company (Del. Corp.), 360 N. Michigan Ave., Chicago, Ill.

PALMOLIVE SHAVING CREAM

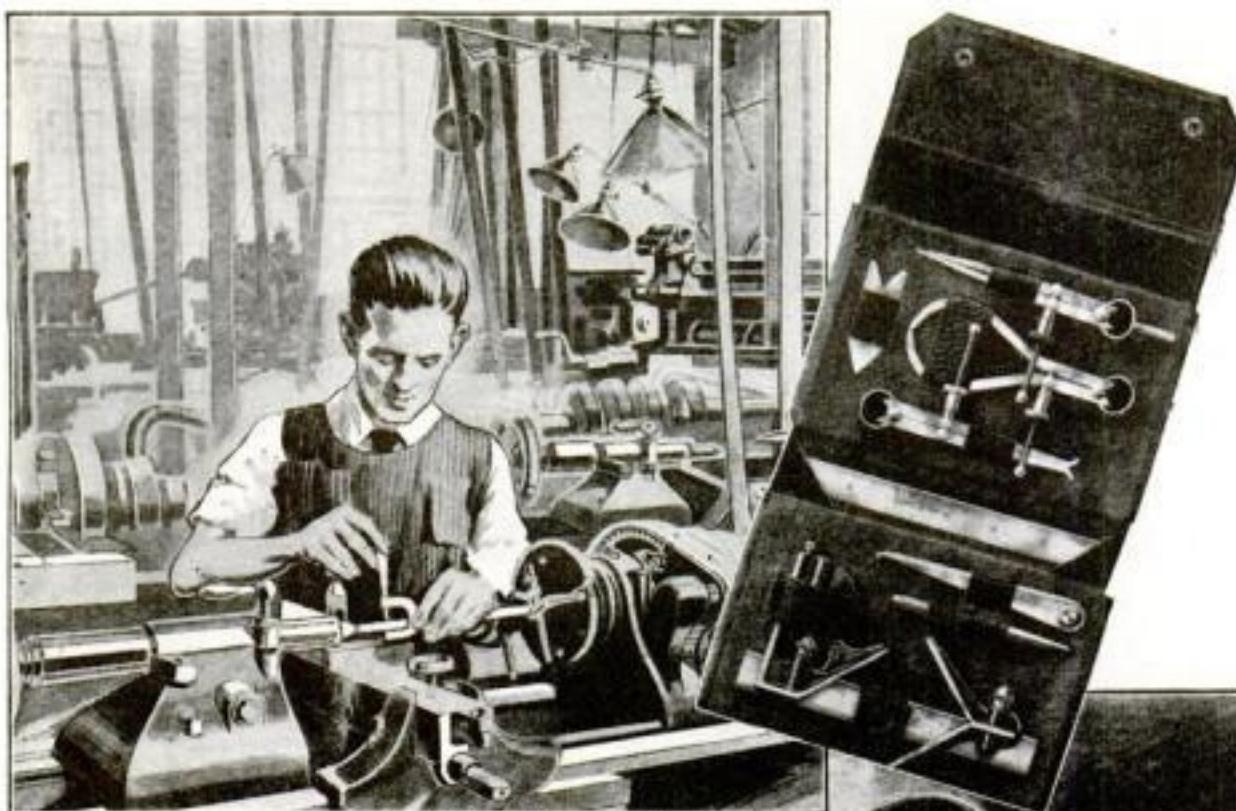
© P. Co., 1924



10 SHAVES FREE

and a Can of Palmolive After Shaving Talc

Simply insert your name and address and mail to
Address for residents of Wisconsin, The Palmolive Company
(Wis. Corp.), Milwaukee, Wis., Dept. B-828. Address for residents other than Wisconsin, The Palmolive Company (Del. Corp.), 360 N. Michigan Ave., Chicago, Ill., Dept. B-828.



**Brown & Sharpe
Set of
STANDARD
TOOLS
No. 847**



*"For the shop apprentice
and home mechanic"*

Here is a set of tools selected by a master mechanist as being essential to every apprentice machinist or home mechanist who wishes to have an outfit of quality tools for a moderate outlay.

The tools are neatly arranged in a felt-lined leather case that provides ideal protection from dust and moisture. Closed, the case is about 7" x 4 3/4" x 1 3/8". This set contains the following tools:

6" Tempered Steel Rule	6" Combination Square
60° Center Gauge	9/64" Center Punch
4" Rex Divider	4" Rex Outside Caliper
4" Rex Inside Caliper	4" Hermaphrodite Caliper

Mechanics the world over depend upon Brown & Sharpe Tools for their quality and lasting accuracy. For this reason Brown & Sharpe Tools have been the choice of mechanics for three generations.

Ask your dealer for Brown & Sharpe's *Set of Standard Tools No. 847*, or, if he cannot supply you, write us. Our Catalog No. 29, listing over 2,000 tools, sent on request.

**BROWN & SHARPE MFG. CO.
Providence, R. I.**

BROWN & SHARPE TOOLS

**Fixture for Tapping Nuts in
the Drill Press**

TAPPING nuts in a drill press is speedy and satisfactory. A cast-iron block is made as detailed with a groove equal in width to the distance across the flats of the nuts to be tapped. A clearance hole is drilled for the tap.

The block is bolted to the drill-press table and an ordinary machine-nut tap is used in the drill chuck. Several nuts may be placed in the block and as fast as the tap is drawn up, another nut is ready to slide against the stop pin. A separate block is used for each size of nut.—H. L. W.

**Graduating a Long Metal Scale
in an Ordinary Shaper**

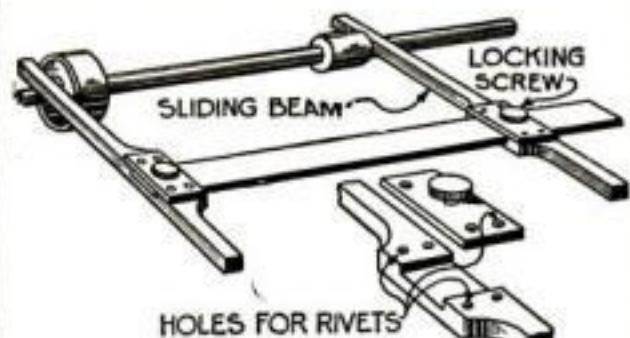
A CIRCULAR-SAW operator needed a scale to go on his 12-ft. sawtable. It was found impossible to purchase such a scale at a price consistent with the requirements, which did not call for extreme accuracy, so the scale was made in the shop in the following manner:

The metal bar was clamped in the shaper vise, and the shaper stroke set so that the tool would pass entirely across the bar. All the inch graduations were cut by passing the pointed tool across the bar. The stroke was then shortened to pass only about halfway across, and the half-inch graduations were marked. The stroke was shortened again to make the quarter-inch and eighth-inch graduations. The result was a clean-cut scale at a very low cost.—R. H. KASPER.

Gage for Awkward Work

THE special gage shown below is designed for measuring in places where other tools would have insufficient range or adaptability.

The beams are movable anywhere on the bar and the gage can be used for inside or outside measuring. One beam may



This gage is useful for work that is difficult to measure with ordinary tools

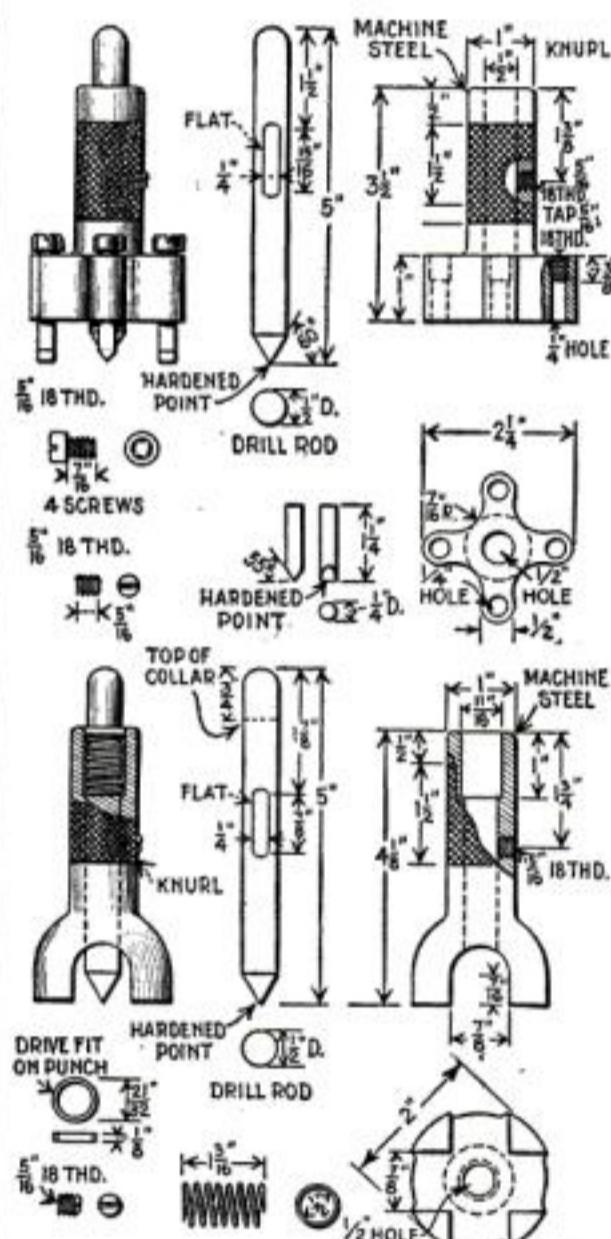
be reversed so that a long and short end can be used together. It also can be used in a vertical position for measuring heights.

The gage is made from drawn steel. The bar should fit neatly in the slot of the beam. A gage of this type now in use has two bars, one 15 and the other 36 in. long.—S. C. HILLS, Torrington, Conn.

Locating and Enlarging Punches Aid in Accurate Layouts

PRICK punching a location accurately with an ordinary punch is difficult, for it is not an easy matter to hold the punch vertically without a guide. For precision work, therefore, a set of locating and enlarging punches such as those illustrated is a valuable addition to the machinist's toolkit.

The guide points of the locating punch follow the center lines scribed in the work by means of four V-shaped scribe points instead of the more usual half V-points. The points bear on the surface of the work



The locating punch and its parts are shown at the top and the enlarging punch below

and, because of the weight of the tool, drop into the scribed lines with a click. A slight tap with a hammer then gives a sufficient impression for the location mark.

The second, or enlarging, punch is not located in the same manner as the other, but is moved about on the flat bases of its four legs until the point coincides with the location punch mark. The spring keeps the point above the work's surface until it is properly located and the punch can be tapped.

Care must be taken to have the punches fit snugly in the bases and to have the axes of the punches at right angles to the base. The locating feet of the first punch must fit tightly, requiring a hard turn on the screws to force them out.

A LINING for protecting tanks from the influence of acids is made from a mixture consisting of 75 parts pitch, 9 parts plaster of Paris, 9 parts ochre, 15 parts beeswax, and 3 parts litharge, all measured by weight.



General Motors Trucks

Power to Pull Out— Speed on the Road!

Watch for the GMC trucks on the next excavating job!

Notice how easily they haul their full load of earth up the steep incline to the street—unaided by cable or team.

Then check up with the driver on the number of loads they haul each day. You will find them as speedy as they are powerful.

For, equipped with the famous GMC Two Range Transmission, GMC Trucks multiply the power of an engine, of economical size, into pull at the wheels that will take them up any grade or out of any mud where wheels can get traction. And, by a shift of a lever, also provide as fast a road speed as safety permits.

This combination of speed and pulling power—built into GMC Trucks—their rugged dependability and their operating economy, all make them money-makers for haulers everywhere.

GENERAL MOTORS TRUCK COMPANY

Division of General Motors Corporation

Pontiac, Michigan

General Motors Truck Co.
Pontiac, Michigan
Department 47

Gentlemen:—I am interested in what GMC trucks can do in the following business:—(Check business)

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| Bakery | <input type="checkbox"/> | Building | <input type="checkbox"/> | Furniture | <input type="checkbox"/> |
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Buy some good tools for the boy, Dad—and [whisper] use them yourself

UP in the attic or out in the garage there are new adventures waiting for the Boy and YOU—adventures with tools in The Land of DOING Things!

What a world of achievement good tools open up! What wonders they can perform!

Begin your tool kit today with a Simonds Hand Saw, Hack Saw and File. You'll thrill to the feel of their perfect cutting qualities. You'll prize each of them as a *real* tool. You'll know why Industry has chosen them for years. They'll make the boy a better boy—his Dad a better man.

But be sure, when you buy your saws or files, to say SI-MONDS.



SIMOND'S SAW AND STEEL CO.
"The Saw Makers" *Established 1832*
Fitchburg, Mass.
Branch Offices in Principal Cities

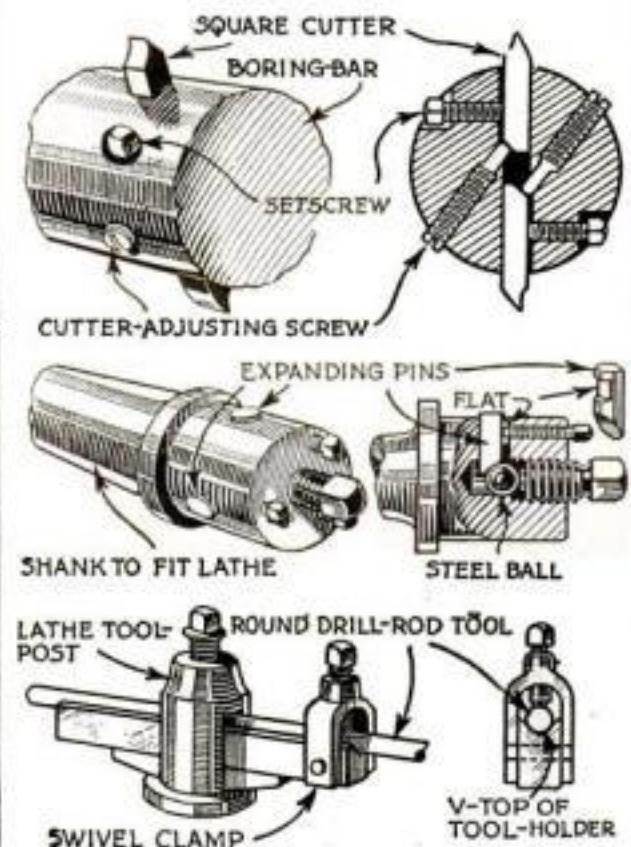
SIMOND'S
pronounced SI-MONDS
SAWS FILES KNIVES STEEL

Boring Bar, Expansive Mandrel, and Lathe Tool-Holder

THREE time-saving ideas for the machinist are shown in the illustration below.

The first is an efficient adjustable boring bar, which may be made at small cost. A square slot is cut through the bar to take standard toolbits. These usually are beveled at both ends when purchased. Holes are drilled and tapped for the adjusting screws. The cutters may be set roughly to size with calipers and locked with the setscrews. They should be ground for size on centers either in lathe or grinder, and properly relieved for clearance. The size then may be changed readily within reasonable limits.

An expansive mandrel is a handy lathe accessory for turning and facing small



The adjustable boring-bar (above), expanding mandrel (center), and lathe tool-holder (below)

gear blanks or similar work. The design suggested in the second drawing has three round pins actuated by a hardened steel ball in contact with a setscrew placed centrally at front end. The pins should be beveled about 45 degrees on one end and each should have a flat spot for a locking setscrew. The pins are spaced 120 degrees apart radially, one or two inches from the end.

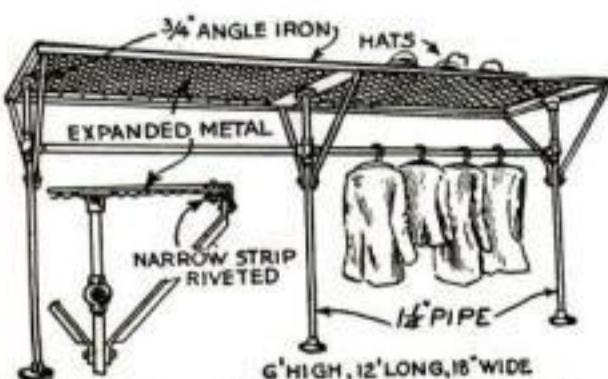
A useful boring tool-holder is the third tool illustrated. It makes use of standard sizes of drill rod or of high-speed steel round stock. One end of the rod is forged to the desired shape and tempered as usual for any tool. The holder consists of a piece of cold rolled steel having a V cut in the top side. One end is fitted with a swivel yoke having a setscrew for setting and adjusting the tool.—H. S. L.

Cutting Cost of Lanterns

CONTRACTORS and others who use guardian lanterns with red shades, know the cost of replacing broken glass. This expense can be reduced by using the ordinary red dye stain made for electric-light bulbs. A bottle costing about \$2 will color several dozen shades.

Shop Coat-Rack Made of Pipe and Metal Lath

A SERVICEABLE shop coat-rack can be made from short lengths of pipe and standard pipe fittings. The top is covered with expanded metal or wire

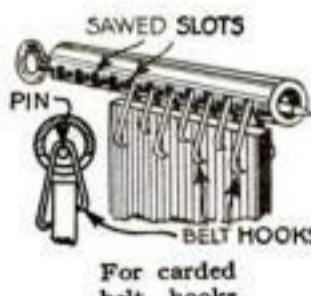


This substantial rack, which is made of standard materials, economizes space

cloth and serves for a hatrack. The three uprights are of 1 1/4-in. pipe fastened to the floor by means of railing flanges. The top frame and braces are made of 3/4-in. angle iron, riveted together. Coats hang on conventional coat-hangers, as illustrated.—A. S. JAMIESON.

Handy Belt-Lacing Tool

I HAVE been using this handy belt-lacing tool for the past year in a small shop for applying carded belt hooks. The tool is made by cutting a number of



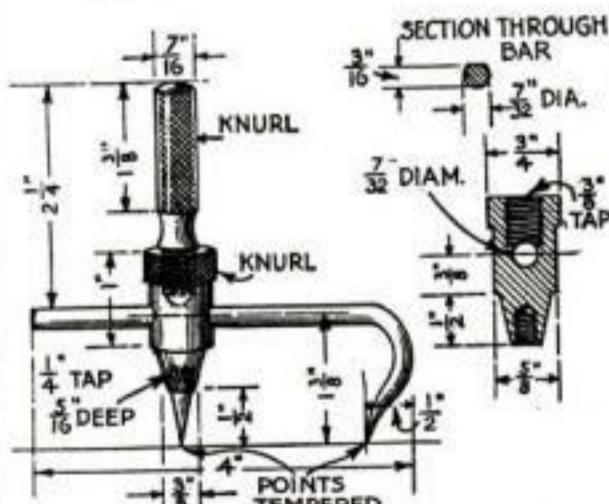
parallel slots in a short piece of 1/8-in. pipe with a hacksaw. The distance between the slots should be determined by the corresponding distance between the hooks on the card.

A length of 12-

gage wire is used as a pin to hold the hooks in place. The illustration clearly shows how the tool is used.—CARLETON SCHLESMAN, Baltimore, Md.

Accurate Dividers for Shop Use

THE difficulties with the average divider are the tendency of the legs to spring, the loosening of the hinge, and the slipping of the pivot joint due to the



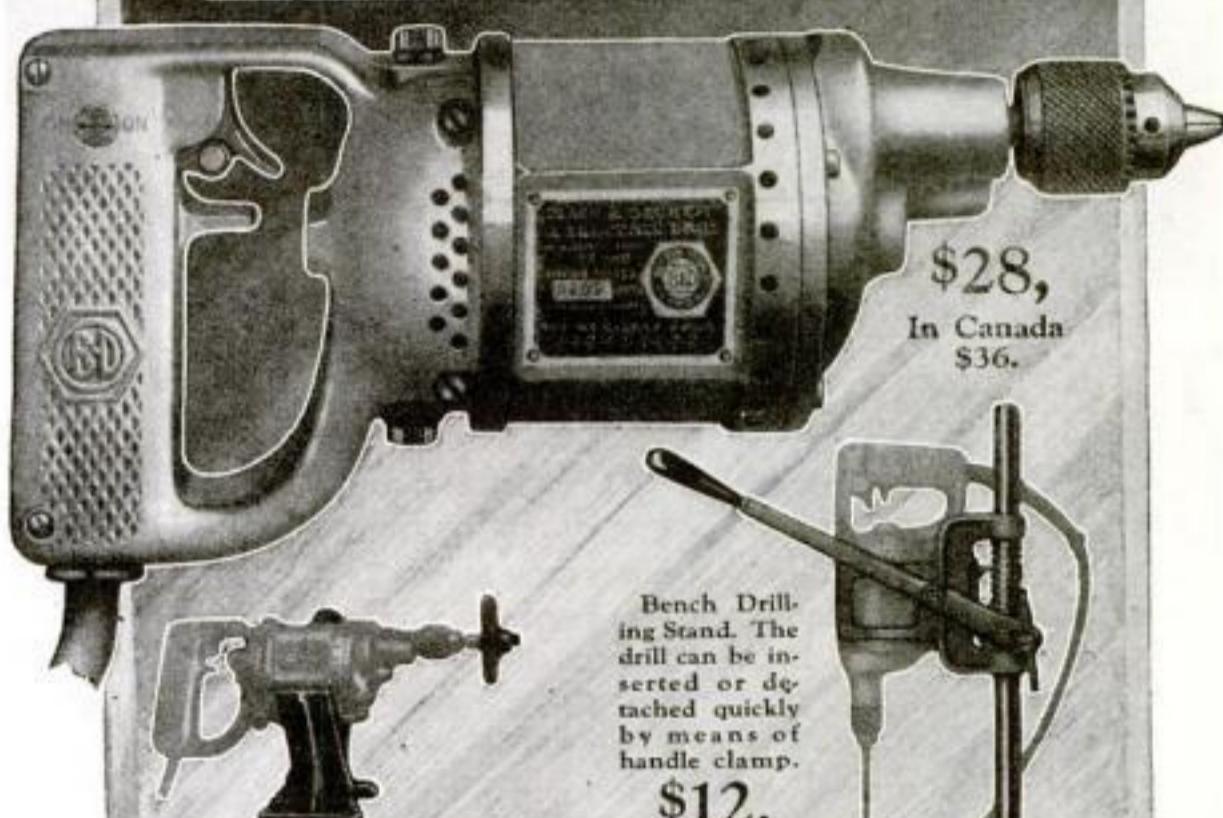
The thick, heavy legs of this type of dividers do not spring or shift in use

fact that pressure cannot be exerted directly above it.

A set of dividers made as shown here will overcome these disadvantages.

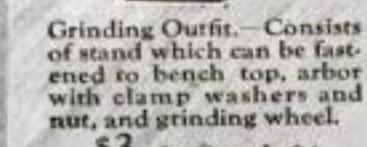
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The Switchboard Comes to Life

Zero hour approaches. Wire chief and assistants are set for the "cut-over" that will bring a new central office into being.

In the room above operators sit at the new switchboard. Two years this equipment has been building. It embodies the developments of hundreds of engineers and incorporates the scientific research of several decades. Now it is ready, tested in its parts but unused as an implement of service.

In the terminal room men stand in line before frames of myriad wires, the connections broken by tiny insulators. Midnight comes. A handkerchief is waved. The insulators are ripped from the frames. In a second the new switchboard becomes a thing alive. Without their knowledge thousands of subscribers are transferred from the old switchboard to the new. Even a chance conversation begun through the old board is continued without interruption through the new. The new exchange provides for further growth.

This cut-over of a switchboard is but one example, one of many engineering achievements that have made possible a wider and prompter use of the telephone.

To-day, in maintaining a national telephone service, the American Telephone and Telegraph Company, through its engineering and research departments, continuously makes available for its Associated Companies improvements in apparatus and in methods of operation.



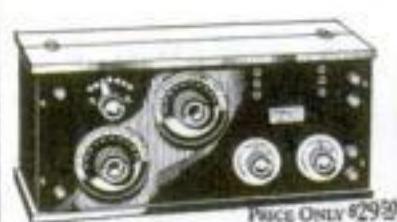
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Cabinets of solid mahogany and workmanship the finest throughout. Order direct or send for bulletin.

Two tube outfit, as shown above, headphones only \$29.50.

Four tube outfit for loudspeaker or headphones \$54.50.

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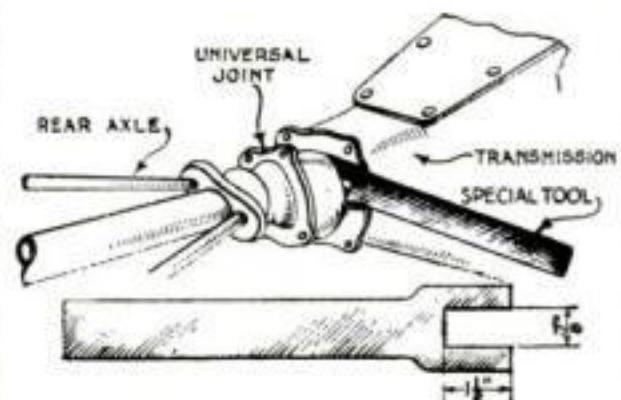
AGENTS—Write for proposition quickly—it's a winner.

THE MIDWEST RADIO COMPANY
808 Main Street Cincinnati, Ohio

Thin Wrench Speeds Work of Replacing Ford Universal

WHEN the rear axle assembly of a Ford passenger car or truck is removed for repair, the replacement of the universal is a time-consuming operation. The square end of the universal must be held true and in exact alignment with the corresponding hole in the transmission.

By the use of a slender-jawed wrench, approximately 10 in. long, the work is



The wrench, made from sheet steel, and how it is used to replace universal

simplified greatly. After the universal has been entered into the casing, this thin jaw wrench is operated through a narrow slit to set and turn the universal until the required alignment has been obtained.

This maneuver cuts down the time to only a few minutes. Sheet iron or steel, which can be sheared out, is used in making the wrench.

Boiling Hammers in Oil to Make the Handles Last

ONE of the old hands in our tool shop was annoyed recently when the head of the hammer he was using flew off. The tool belonged to an apprentice, so he took the time to replace the head himself, after sandpapering the end to a perfect fit. He drove the wedges in the usual H form, sandpapered the end, and put the hammer in a can of linseed oil. This was placed on top of the shop salamander and the hammer was boiled slowly for three hours.

"My own hammers were treated in this way 10 years ago," he told the apprentice, "and the handles are still tight and good for 10 years more."—F. N. C.

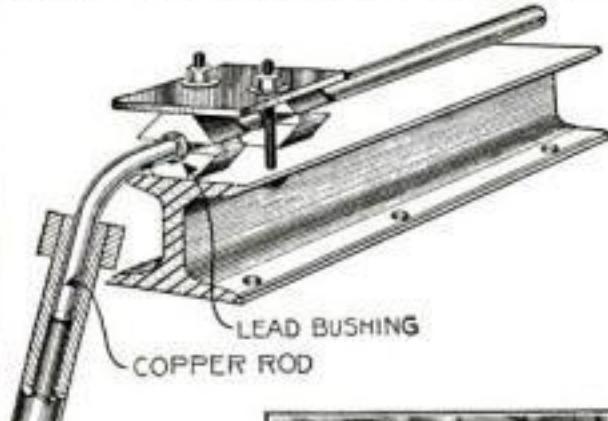
Cutting Commutator Mica with a Homemade Tool

ELECTRICAL workers who have much commutator work to do will find this mica-cutting tool a time saver. The handle, which is made from hard wood or fiber, is slotted to take a short length of hacksaw blade. The blade is held by two bolts, which pass through angular slots in the handle and vertical slots in the saw.

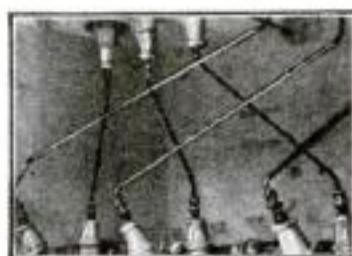
The slots allow the blade to be set at an angle when the work so requires.—FRANK N. COAKLEY, Buffalo, N. Y.

Scrap Parts Used for Ingenious Rod-Bending Fixture

WHILE on construction work at a large Australian electric power station recently, I had to connect seven large oil switches with 1-in. copper rods having double cones and nuts at each end. It was absolutely necessary to bend them to come correctly to their places within 1/32 in. The company could not supply a bending machine, so I made the fixture



Construction of the bending machine and the type of work done with it



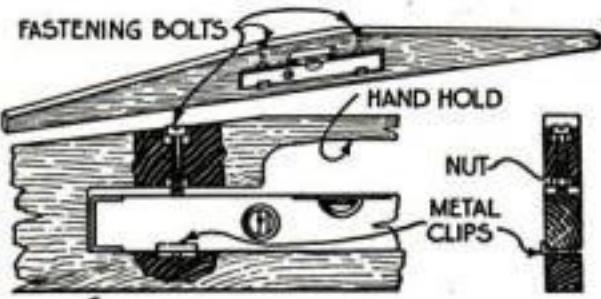
illustrated from material picked up from the scrap heap.

I filed the thread almost out of two 1 1/4-in. nuts and sawed each one in half. From a piece of 1/8-in. lead cable sheathing I made two bushings, cut them in two lengthways and placed them so as to project 1/4 in. beyond the nuts. A 6 by 4 by 1/2 in. mild steel plate was used to hold the nuts down on a 6 by 6 by 3/8 in. I beam, 4 ft. long. The bending handle was a 3-ft. length of 1-in. pipe with a steel collar shrunk on the end, the sharp edge on the inside being filed away.—H. B. J. LOWE, Melbourne, Victoria, Australia.

Combined Straight-Edge and Level for Large Work

A USEFUL tool used by one jobbing carpenter is a straight-edge about 8 ft. long with a recess for holding a builder's 18-in. level. This saves the time of handling the usual plumb line, straight-edge, and level separately.

The device, which is made according to the accompanying drawing, is used for



An ordinary carpenter's level is attached with clips and bolts to a straight-edge

brick and concrete work, framing, cement floors, and all construction that requires the leveling or plumbing of a relatively large surface. The normal use of the level is not interfered with, and the straight-edge also may be used independently.—G. A. L.



Sargent Auto-Set Bench Plane



Sargent Steel Block Plane

Sargent Planes make a quick, clean job of it

WHATEVER it is—if it is made of wood and needs smoothing or finishing—one or the other of these two Sargent Planes insures satisfaction.

For heavy work, or where good deep cuts are desirable, the Sargent Auto-Set Bench Plane fills the bill in every particular. At the same time it is an excellent smoothing and finishing tool—an all 'round plane for the busy workshop.

Examine the Auto-Set at your hardware dealer's. Note how quickly the cutter of chromium

steel may be removed and replaced when it does need sharpening—all without disturbing the original adjustment. Back in place, not even the toughest or knottiest wood can make it chatter.

For the smaller jobs, for cabinet-making, for getting into real close quarters, and for the finishing touches to your workmanship, you need the Sargent Steel Block Plane. This is made with the same care and precision which characterize every tool bearing the name Sargent.

These two Sargent Planes should be on your work-bench. Write for booklets.

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Secrets of Cutting Threads

(Continued from page 76)

back by hand. This is much faster than waiting for the carriage to reverse with the nut on the screw. Expert hands can do this without stopping the lathe. This is accomplished by backing the tool out quickly at the end of the cut and running the carriage back to the chalk mark on the way, the spindle running all the while. With the right hand on the nut lever, watch for the chalk mark on the faceplate to come around to the front way and throw in the nut. The tool, of course, is set in for another cut and run in to the stop. This requires alertness on the part of the operator, but with a little practice it is not hard.

ON ALL modern lathes provided with a dial indicator for cutting threads, the chalk marks are unnecessary; this is used only on old style lathes. The compound rest is set at 30 degrees, or half the angle of the thread, and the point of the tool approaches the work each time it is fed in without altering the true angle or lead of the thread. This allows the tool to cut on one side only and prevents a burr.

There are, of course, some cases where it is impossible to set the compound at this angle, in which case the thread will have to be cut with the tool at a right angle to the work.

Threaded parts always should be fitted to each other for accurate work. Cut the screw down nearly to size, measuring with thread calipers, and then finish the thread by trial with the nut or corresponding part. When the correct size is nearly reached, clean and oil the thread after each cut.

The diameter of threaded work is measured, of course, from the top of the threads and represents either the greatest diameter of the screw or the greatest diameter of the threaded hole. The root diameter is measured at the bottom of the thread.

One of the handiest devices for setting thread tools is the gage shown at the top of Fig. 2, page 78. It is used, as shown in Figs. 2 and 3, to set a threading tool level with the center of the work and square at the same time.

The method of setting a tool for a 29-degree thread with an Acme Standard gage is Fig. 4; and in Fig. 5 is illustrated the use of a center gage in setting a thread for cutting an internal United States standard or V thread.

IF THE work is cast iron, the thread should be cut dry; if steel or wrought iron, lard oil should be used. Use oil on all work when fitting it to a mating part, so that there will be no chance of the pieces seizing in such a way as to make it difficult or impossible to separate without damage to one or the other.

Half the battle in thread cutting is to be sure the set-up is right. Try out the tool and thread on an extra piece, if possible. This takes time, but it is better to be sure than to have to explain a "bull" to the foreman.

All good machine tool work depends on one thing: Be sure you are right before going ahead. If in doubt, don't take

(Continued on page 89)



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IN this Simore Combination Knife and Screwdriver, there are three blades in the handle. Each blade snaps back into the handle after it has done its duty just as is shown here. And you select and produce the blade you want by gravity just as easily and quickly. You actually change blades instantly with this tool.

Model No. 12, with knife blade and two screwdriver blades. Only **\$2.25**.

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They please. Write for free catalog.
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Secrets of Cutting Threads

(Continued from page 88)

a chance and hope things will come out all right. In threading, go slow and be sure.

Generally speaking, for threading operations, place the belt on the largest pulley of the lathe cone, if a belt-driven lathe. Then screw on the faceplate, fasten a dog on the work, and place the work between centers. Chalk mark the slot in the faceplate where the dog engages it. Always keep the dog in the chalk-marked slot throughout the work. Turn the work to the screw diameter, measuring with "mikes." Have the finish smooth.

Next set the thread tool, the form of which depends upon the thread to be cut. Use a gage to make sure the tool is square with the work and even with the center. Adjust the thread stop that allows the cross feed to be adjusted in thousandths. Set the gears for the thread wanted and be sure the friction feed of the carriage is out before engaging the nut. Place a tin box under the tool to catch the oil. Adjust the micrometer stop on the cross feed so that the tool clears the work by about .001 in. Start the lathe and adjust the micrometer stop on the cross-feed so that the tool traces a very light line on the work.

Stop the lathe before the tool reaches the end of the thread and finish the length of the thread by pulling the belt by hand. This is necessary the first time only.

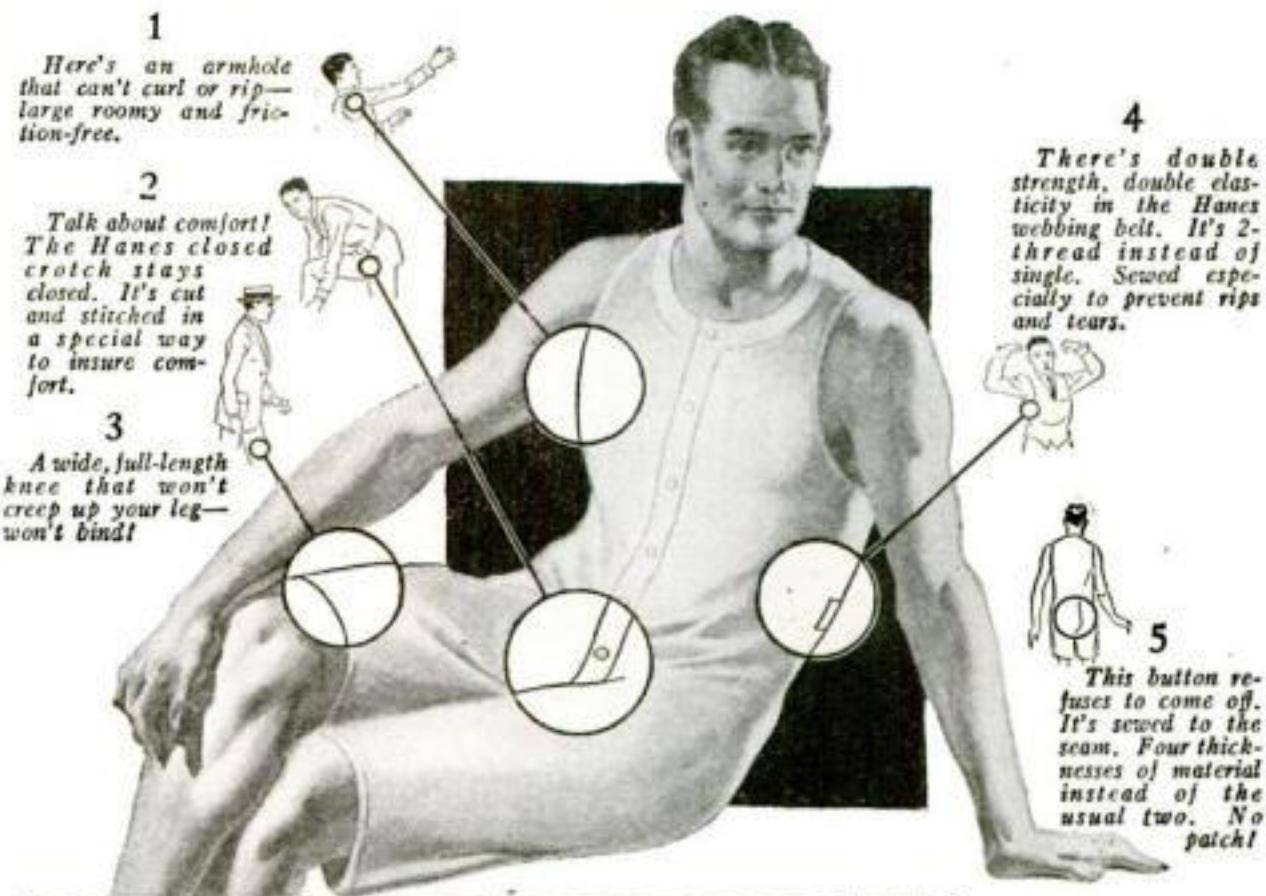
MOVE the tool out from the work, run the carriage back by reversing the carriage feed and adjust the micrometer stop to make another cut of .003 in. more. Now check your threads. If they are correct, start the lathe and take another cut, pulling out the tool about one-third of a revolution from the end of the thread. Reverse the carriage, and while the tool is running back, lubricate the work freely with a brush dipped in the pan under the tool. Keep the work clean and take cuts of .005 in. when roughing down. For finishing, the cuts should be about .001 in. or less. Keep trying for size and remember that after the thread is smoothed down it may be too loose. If the screw can be turned into its mating part by hand before the burrs are removed, it will be too loose after they are removed. The threads may be lapped by means of a split nut that has the same thread.

A gooseneck thread tool (Fig. 6) makes an especially smooth thread, as the tool springs down from the work when overloaded.

Left-hand threads are cut by fixing the gears as in cutting a right-hand thread, with the exception that the lead screw must rotate in the opposite direction.

In cutting inside threads to a shoulder, a groove must be made inside the work at the end of the thread, as in Fig. 1. This groove must be a little deeper than the full diameter of the threads. Place a line on the thread tool as a guide, the tool being set into the work at the groove.

SHOP features scheduled for early publication are "Methods for Locating Holes in Jigs and Dies," "How to Scrape Metal Surfaces Accurately," "Making the Most of a Drill Press," and "Shortcuts in the Use of the Shaper and Planer."



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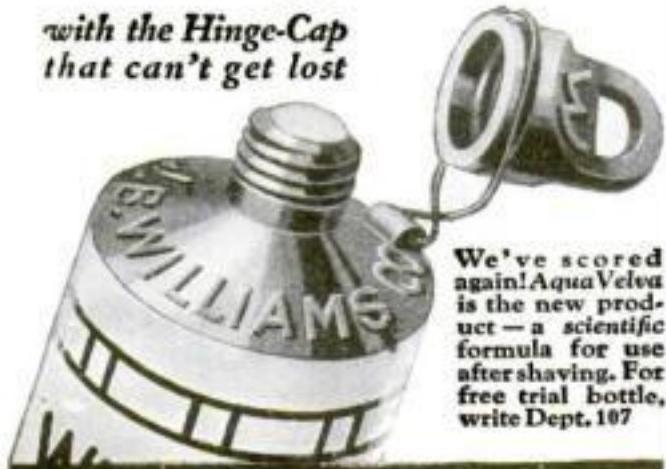
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Wooden "Ponies" for Water Games

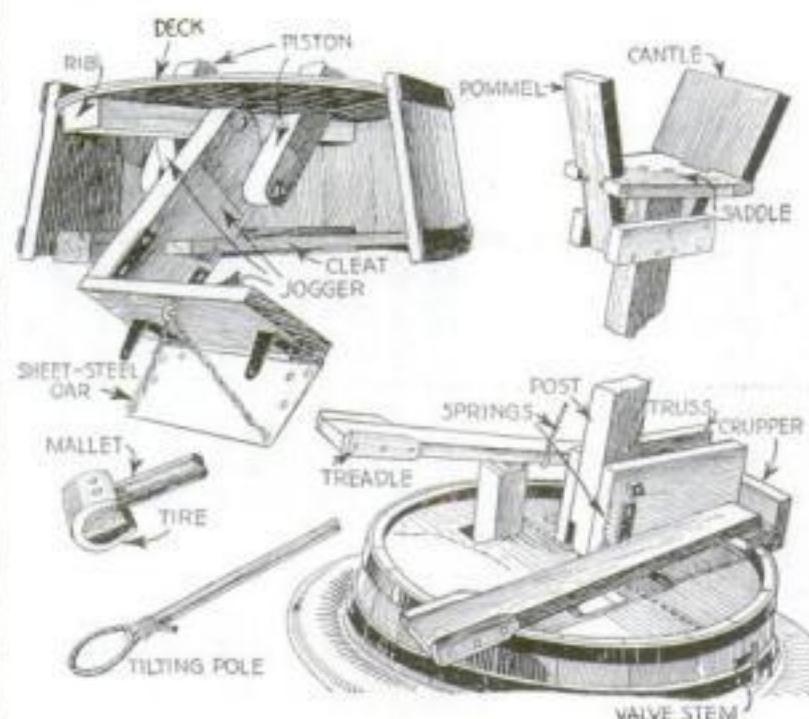
WATER polo is keen and hilarious sport for the rider of one of these skittish ponies. To jog the "animal" about the "field" and dribble the ball over a goal, requires skill that makes a real game, although the apparatus is homemade and inexpensive. And any playing arguments can be settled by a tilting contest—a regular medieval joust, most amusing to onlookers.

All this aquatic fun is perfectly safe, for a discarded auto tire buoys up each pony. A 10-in. piece cut from the end of a molasses barrel is suitable for a flivver tire. One hoop clinches the tire above its rim.

Below deck, two joggers work independently, each hung between 2 by 3 in. ribs and an outside cleat. Center one rib across directly under the barrel head and fasten another to the stave ends below.

A jogger is formed with 12 in. of a two-by-six, and a 12-in. board arm attached with two corner braces set into the plank. At the other end of the plank, trim off a 3-in. corner and bore bolt holes 5 in. apart and 1 in. from the edges.

A sheet-steel oar is riveted to two 6-in. strap hinges under the board. Fasten each strap with three screws, and bend about



Construction of the aquatic horses. For clearness, one of the two foot-driven oars is omitted from upper view

2½ in. of the end at right angles to serve as a stop. When propelling, a chain holds the oar at right angles to the board.

Above deck draw a center line (shown dotted) at right angles to the rib. At one side of this line and directly over the rib, bore a 2-in. post-hole. To the rear, 3 in. from the center, pivot the joggers to the rib with an 8-in. bolt. Cut a seat-post 36 in. long, with a 10-in. end to extend below, preferably into the lower rib. A two-board truss, 6 in. high, supports the post and allows it to be adjusted for height and balance. Set a corner brace at each side.

The truss is braced at the rear by a two-piece crupper, 14 in. long. Let the base be 3 in. wide, set into the truss, and nailed over the barrel rim.

Cut a treadle 3 in. wide, to extend about 4 in. beyond the deck when hinged to the edge of the crupper with a 3-in. butt. Each piston or plunger opening is 4 by 2 in., located 1 in. from the cross line and

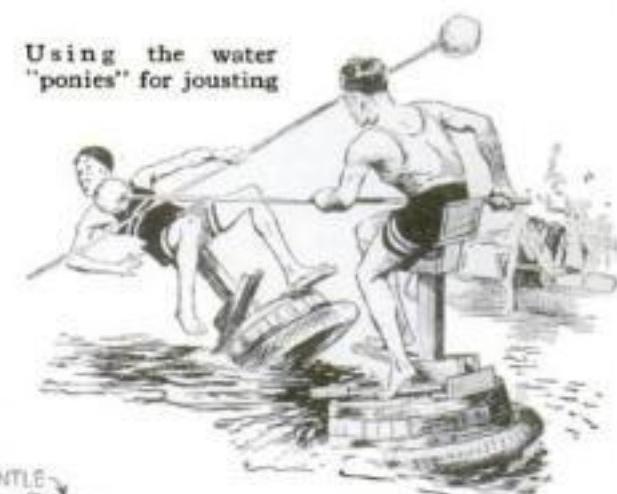
3½ in. from the rib center. Make each piston 2 by 2 by 10 in. and center the bolt hole 1 in. from one end.

The saddle is formed by a pommel 3 by 14 in. long, a cantle 7 by 13 in., and a 7 by 11 in. seat. Padding may be old inner tubes covered with canvas. Connect the treadle springs with the post for quick action. Foot cleats should be used on each treadle.

The materials needed are:

1 board, ½ by 7 in. by 2 ft. long	1 board, ½ by 6 in. by 12 ft. long
1 two-by-three, 6 ft. long	1 two-by-six, 3 ft. long
4 strap hinges, 6-in.	4-ft. jack chain, 1-in. link,
2 butt hinges, 3-in.	2 door springs, ¾ by 16 in.
2 butt hinges, 2-in.	1 bolt, 5/16 by 8 in.
6 corner braces, 4-in.	3 bolts, ¾ by 4½ in.

Using the water "ponies" for jousting



4 pcs. galvanized sheet steel, 6 by 10 in.
1 automobile tire and tube, discarded stock
4 doz. screws, No. 8, ¾-in.; 1 doz. screweyes, 1 ½-in.; ¾-in. rivets; washers; 10d. nails.

A mallet is made with a 5-in. length of flivver tire, a 2 by 3 by 3 in. block, and a handle 3½ ft. long. Shape a ball 4 or 5 in. in diameter from some light wood or use a 6-in. water ball if there are several players. For tilting, use a light pole about 9 ft. long, to one end of which is wired a 16-in. door spring, as indicated, for holding the padding of cotton waste.

The game may be adjusted to polo rules, or simply "nip and tuck" to goal the ball. A tilting contest consists of equestrian maneuvers and "hit-or-miss" jabs until somebody gets a ducking.

Coming Workshop Features

BUILDING Radio into Your Home," by Kenneth M. Swezey.

"Making a Six-Inch Jointer for the Home Workshop," by Frank N. Coakley.

"How to Construct Airplane Kites," by Charles M. Miller, leading authority on kite flying.

"A Grub Box for the Canoeist," by Leroy W. Hutchins.

"Saving your Engine Bearings," by Ray F. Kuns, author of "Automotive Trade Training," and one of the foremost experts in his field.

Profitable Outdoor Work for the Amateur Mechanic

WOODWORK that can be done outdoors has special attractions for the amateur mechanic at this time of the year. It is a real pleasure to take toolkit and sawhorses outside in the long, light summer evenings and build something useful and ornamental for the house, porch, or garden.



Arbor with gate and seats built from Blueprint No. 9 in the Home Workshop Series

seats shown in the accompanying illustration. This was built by Orbrey K. Miller, of Bellevue Park, Richmond, Va., from the details in Blueprint No. 9.

Other good blueprints for the summer are Nos. 10, 11, 23, 25 and 34, in the list below.

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to provide, upon request, information relative to tools, material, or equipment.

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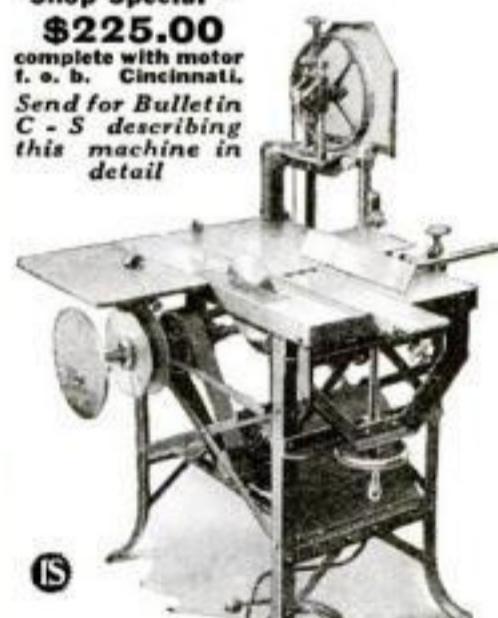
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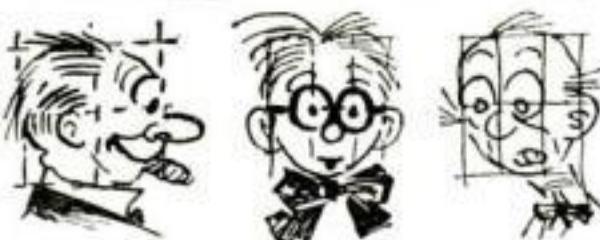
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Trick Water Swing Furnishes Hilarious Summer Sport

By Dale R. Van Horn

AT ANY summer camp this trick water swing will afford lots of fun and excitement. Select a tree limb overhanging the water and to it fasten two pulley blocks. Run the rope over them and bring the ends down to within reach of the seat, which should hang about 1 ft. under water, as indicated. Either splice the ends to the main rope or bind them tightly with cord so that they cannot pull loose.

The bather stands on the swing seat and by pulling the rope ends, raises himself out of the water. When the seat is



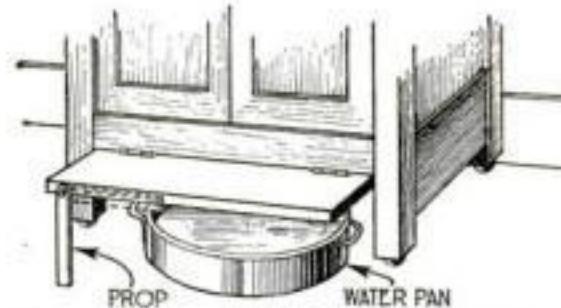
At full speed, the swimmer swings through the water in showers of spray

clear, he holds his arms in the slack to keep the swing at this length, and begins to swing. Faster and faster he goes until finally, at the highest point of one of the swings—at the point of rest—he lets out the slack. With a great splash, the swing strikes the water and passes through it, throwing up a heavy spray.

The best way to take the water dive is sitting down, which can be accomplished by the bather's sliding his hands down the rope and dropping to the seat, feet foremost. If the slack is released at the moment of rest at one end of a swing, there is no danger.

Improving an Icebox

THE swinging door at the bottom of many types of iceboxes often has no catch for holding it up while the water-pan is being removed for emptying. In such cases it is an improvement to fasten



Hinged prop drops down and supports swinging door while water-pan is being emptied

a thin strip of wood loosely with a nail or screw to the bottom, as indicated, so that it will fall down when the door is lifted and act as a prop to hold the cover open when removing pan.—E. B. HILL.



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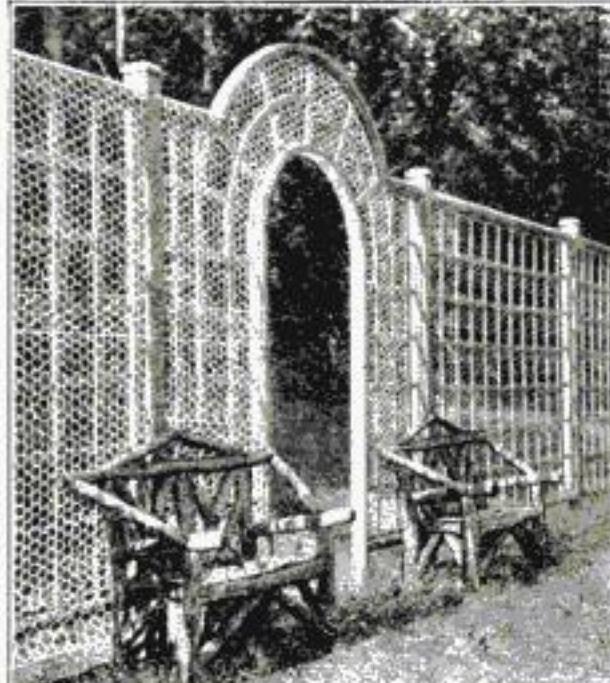
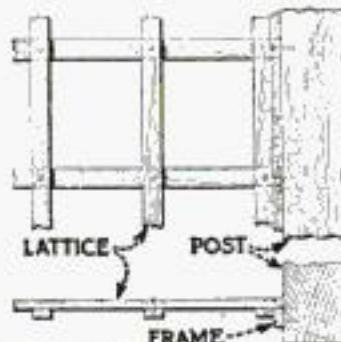
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INCLOSING A TENNIS COURT

By Frank W. Harth

WHILE a tennis court usually is considered only a place for amusement and exercise, there is no reason why it cannot be as ornamental and pleasing to the eyes as any other piece of landscape architecture. As a rule, a tennis court is laid out in some corner of the yard or garden with nothing surrounding it but grass or perhaps an ugly inclosure of poultry netting.

The beautiful and ornamental inclosure illus-



Entrance to the inclosure, with rustic benches. A detail of the woodwork is shown above

trated may be constructed easily of material that can be obtained from almost any lumber dealer. The corner posts can be three by threes or four by fours set into cement, or held in place by stones with the earth firmly tamped around them. The construction of the archways, at first thought, may seem a difficult problem. The method is to bend thin strips to shape, using enough strips to form a square cross section.

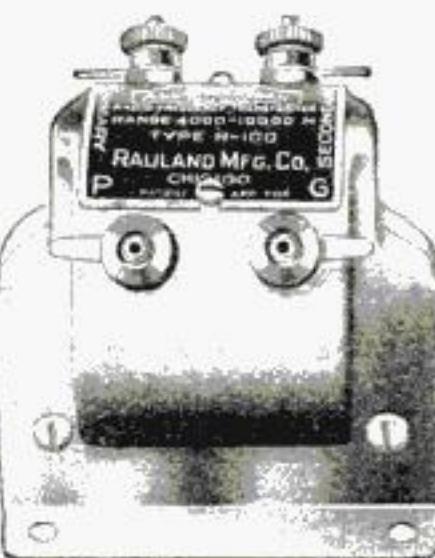
The lattice work can be made of ordinary shingle lath fastened to the framework, which is made up of common furring strips nailed to the posts as shown in the detail. Several coats of good outside white paint finish the job.

Scratchless Fly Swatter

FLY swatters made from old inner tubes never scratch the furniture as broken wire ones sometimes do. Fasten a piece of the tube to a flat stick with tacks driven through pasteboard washers and slit the rubber up in a number of places with the scissors.—S. R. R.



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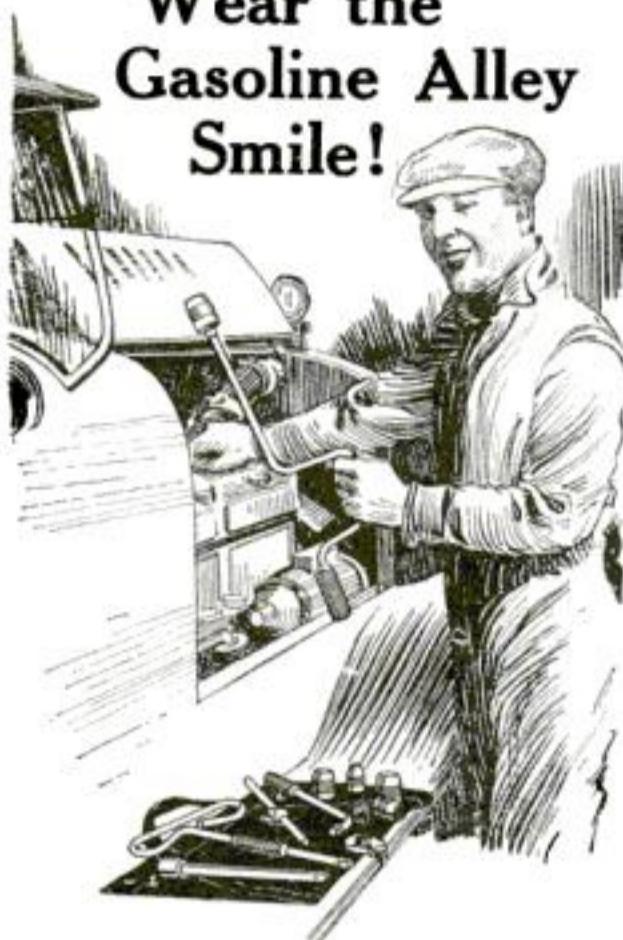
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Saving Your Auto Engine Bearings

TWO neighbors buy cars of the same make on the same day. They drive them approximately the same mileage the first season. At the end of the season each has paid about the same amount for maintenance and repairs. However, one car is in prime condition; the other is about ready for a complete overhaul.

"I have driven that car 38,000 miles," an owner told a service man the other day. "I want you to take down the crankpan, clean it out, and put it back with new gaskets. It has been using too much oil lately, and I am sure the gaskets must be bad."

"Do you want the bearings taken up while you have the pan down?" he was asked.

"I should say not!" he replied.

"I am taking care of those bearings and would not have them touched for anything. I want to see how far they will go without being touched."

Manufacturers are perfectly safe in guaranteeing their engine bearings for 25,000 or 50,000 miles of service on condition that the proper care is given the lubrication. A properly designed bearing will just polish up nicely in a season, and after that there is no appreciable wear if the oil is right.

I have just looked over two engines, one a 1913 and the other a 1923. Of the two, the 1923 model is far the older, with bearings scored and broken. The 1913 model has a fine polished brown glaze over the Babbitt surfaces and shaft journals and pins are like glass. Except for a minor trouble, the older car need not have been laid up now. The later model needs some new bearings and a complete overhaul.

IF THERE is clean oil in the bearings, the oil takes the wear. If the oil is dirty, thin, or worn out, the shaft cuts through it and rides on the surface of the babbitt, scoring it and wearing it out.

When the time comes that engine bearings need care in the way of adjusting or scraping—taking up, as it is called—the oil pan or inspection plate at the bottom of the crankcase is dropped.

First, inspect all bearings to see if they show signs of burning. If they have been badly mistreated, babbitt will show in the oil trough in the crankcase. If a decided knock has been indicated, learn which bearing is at fault.

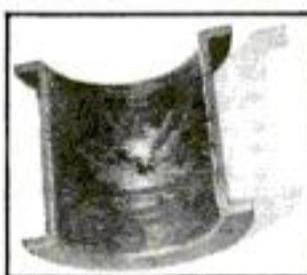
Second, inspect all bearing caps to see that they are marked in a manner to identify them. Usually, the rod bearings are marked 1-1, 2-2, 3-3, etc., on the cam-shaft side and running back from the front of the engine. Note the identifying marks on the main bearings as well.

Third, proceed to remove the bearing

By Ray F. Kuns
Author of "Automotive Trade Training"

caps one at a time and adjust them. When a bearing cap is pulled off, make certain that the shims between the halves are kept in their proper position. Mixing shims will cause hours and sometimes days of hard work. Carefully remove the thinnest shim found on each side, or if the shims are of the patented type, pull or peel off a thin layer. Next, reassemble and draw the bolts quite tight. Use a socket wrench for this work. With the bolts tight, it should be possible to detect just a slight drag when the engine is turned over with the hand crank.

At left is a relatively new bearing that has been burned badly because of inadequate lubrication



At right is an old bearing in perfect condition because it has been oiled properly



In some cases it is necessary to dress the shims down with a file to get the proper adjustment. In other cases it is necessary to draw-file the caps. Extreme care is essential to success. It will not do to loosen the bolts a bit, as is the first impulse of the amateur. The bearing studs or bolts must be absolutely tight and the shims pinched hard. Add or remove shims, draw-file caps, and test and re-test until just an appreciable drag is noticed. That bearing is then finished.

BACK off the nuts a turn and adjust the other bearings, then go over the bolts and nuts and set them to the predetermined tight position, locking them with the cotter keys.

If removable dippers are provided, see that they are assembled to dip properly. In some instances they can be assembled backward.

Before replacing the crankcase, see that all oil tubes and oil holes are clean. Cleanliness and thoroughness of inspection mean a great deal. Make certain new gaskets of the proper thickness are used when replacing the crankcase, else the oil dippers on the rods will give too little or too much oil. Make the job tight with shellac to insure economy of oiling.

Drain oil every 500 to 800 miles and refill with good oil of the proper grade.

Keep the crankcase gaskets tight, check the oil pressure gage constantly to see that the pump is working, keep the engine properly cooled, clean the crankcase each season by removing it, and satisfactory results will be assured.



WHEN an auto is used much, the rear floor often becomes worn to such a degree as to be unsightly. The old carpet or rubber mat may be replaced, however, with a piece of cork linoleum, cut to fit, and painted any desirable color. A mixture of shellac and dry color, such as Venetian red, gives good results although paint or varnish will perhaps be more durable.—R. N. ROAT, Kankakee, Ill.

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Shielding Radio Apparatus

I HAVE found that an easy and efficient method of shielding panel-mounted radio instruments is to coat the back of the panel with aluminum or other metallic paint. By this method the panel can be covered close to the different shafts and binding posts with little danger of short circuits. The painted surface must be connected with the ground.

The interior of a cabinet can be shielded in the same way. In my own set I provided a connection between the cabinet shielding and the ground by fastening a short length of wire to the interior of the cabinet before applying the paint and then flowing the aluminum thickly over it.—WILLIAM J. EDMONDS, Jr., Whitehall, N. Y.

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At work with a hand tool, you see how the work goes on and how well the tool performs.

But with the multiplied output of a machine tool or "automatic," you can see only from *counter* records how the work goes on and the machine works out.

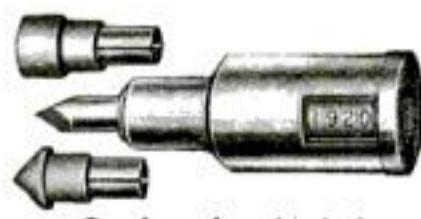
The machine—like the hand tool—gives *results* according to how it is used and *adapted* to use. You'll develop its service like developing skill with a hand tool—using a

Veeder COUNTER

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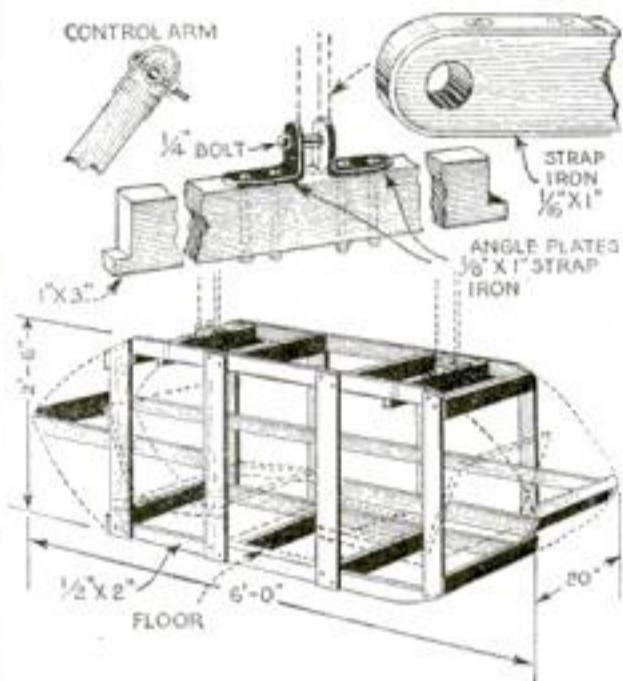
The Veeder Mfg. Co.
44 Sargeant St., Hartford, Conn.

How to Build a

By Donald W. Clark

SAFE and thrilling fun for small children is furnished by the novel swing illustrated. The youngsters sit in a closed cabin like the miniature of a dirigible's gondola. When once the swing has been started, it is kept going simply by pulling a rope that hangs down alongside the car.

To construct the swing is not a difficult task for any man handy with woodworking tools. A frame of 1 by 3 in. strips of



Details of the unique swing, which is kept in motion by pulling a control rope

any strong, hard wood available is bolted and screwed together as for a conventional garden swing. This framework is 9 ft. wide at the bottom, 4 ft. wide at the top, 5 ft. deep, and 10 ft. high. In other words, it occupies a ground space of 9 by 5 ft., and the top is a rectangle 4 by 5 ft.

Running across the top are two pieces 20 in. apart, each 10 in. from the center line, and from these the gondola is swung. Each piece has two metal bearing plates

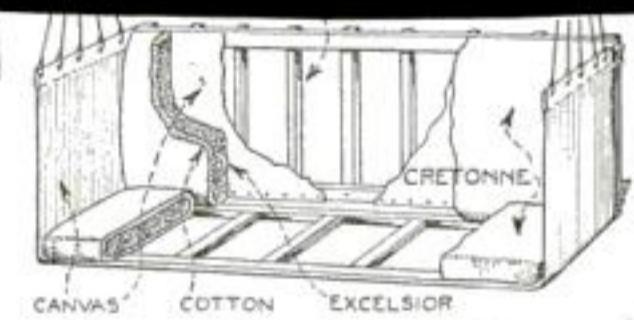
Rebuilding a Porch Swing

WHEN porch swings were quite high in price, a year or so ago, we purchased one with a canvas instead of a cushion back. After putting up with this uncomfortable affair for two summers, the back was remodeled as follows:

The cypress strip forming the support for the canvas back was removed and another strip was cut the same size. Three strips $\frac{3}{4}$ by 2 by 18 in. were then screwed to the long pieces, one at each end, the other in the middle. Six more strips, $\frac{3}{4}$ by 1 by 18 in. were screwed to the frame already made, spaced equally between the wider pieces.

The canvas removed from the old back then was stretched tightly on the new frame and tacked to each cross piece. Excelsior was placed over the canvas and bound to each cross piece with cord. Over this a 2-in. layer of cotton batting, fluffed out slightly, was placed and bound with cord.

Cretonne was used as a covering, and a cover to match was made to slip over



The wooden frame is covered with canvas, excelsior, cotton, and finally cretonne

the old cushion seat. Cretonne also replaced the canvas side pieces. The new back was held in place by five snap hooks.

The whole cost was about \$4, but we had a swing that compared favorably with the \$25 ones in department stores—and that was just as comfortable.—W. J. LAUBENSTEIN, Cleveland, Ohio.

Cocoanut Shell Home Built to Suit Jenny Wren

By Leroy William Hutchins

JENNY WREN is a fastidious bird. And, having fine sensibilities, she must loathe the unsightly tin can to which she often is forced to resort for a home. It is doubtful, also, whether she admires the elaborate little man-type houses generally built for her.

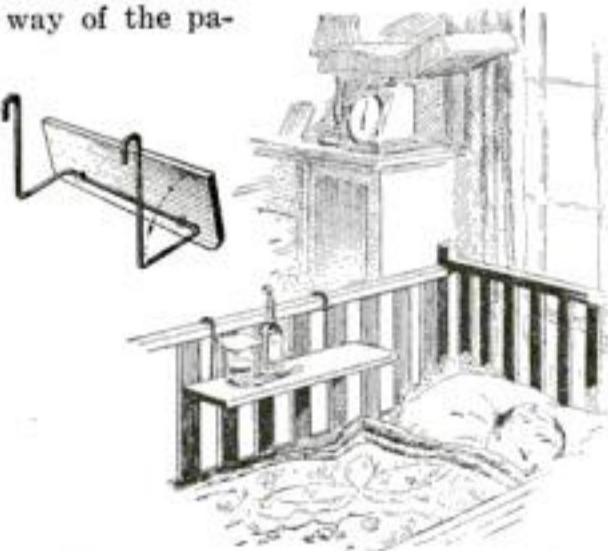
For these reasons it is suggested that a cocoanut shell be used for her home. It is artistic, inconspicuous, and cheap and easy to make.

First sketch a line around the nut, midway between the ends. At some point on this line, roughly centered, draw a circle the size of a quarter dollar. Establish four equidistant points on the line and mark points $\frac{1}{4}$ in. to each side of them, eight in all. Mark another point about $\frac{1}{2}$ in. below the edge of the little circle, and a second on the opposite side of the nut for holes to receive a perch.

Now, using a $\frac{1}{8}$ -in. drill, bore holes at the eight points, make holes for the perch, and bore a ring of holes just inside the entrance circle. Drain out the "milk" and hacksaw the nut in half on the line. After breaking out the meat of the nut, which, of course, may be dried for cooking, the halves are ready to be fastened together by running copper wire through the small holes from the inside, a piece to each pair. When all are in place, the ends should be pulled tight and twisted together. The shell then is ready for occupancy.

Folding Shelf for Child's Bed Useful in Sickness

THE folding shelf illustrated is useful for holding medicines, spoons, glasses, and the like when giving attention to a child who is ill. Everything is in reach of the nurse and yet the shelf can be folded back out of the way of the pa-



When not needed, the shelf folds back against the side of the bed

tient simply by raising the board. It is made from the side of a wooden box to which is fastened rather loosely with staples a length of $\frac{1}{8}$ -in. wire that has been bent as shown.—H. W. LEUTNER.

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How to Clean and Refinish Your Motorcycle

By Austin G. Tribute

AFTER two or three seasons a motorcycle takes on a dingy and sometimes battered appearance. The engine, which may run just as sweetly as ever, has accumulated deposits of black, greasy mud, and the rough iron of the cylinder fins shows red with rust. To restore the original bright, attractive appearance is work any rider may do himself. A thorough cleaning and re-enameling are necessary.

The work should be commenced by taking the machine to pieces systematically, the procedure varying with the different types of motorcycle. As a rule, the engine may be removed from the frame first, and following this, the tank, seat, wheels, mudguards, toolbox, and other accessories.

The bolts and nuts of the several units of construction may be kept in labeled tin cans. The object is to separate the component parts so that they may be cleaned thoroughly, as this is the basis of success in enameling.

Gasoline is one of the best solvents of dirt, and this used in conjunction with a



Rubbing off the old enamel with steel wool and method of painting the wheels

putty-knife and an old brush will leave the surface ready for the removal of the old paint.

Any of the paint removers on the market will be satisfactory. Apply the liquid with a brush, and with a handful of coarse-grade steel wool in your gloved hand, wipe the metal clean and bright. Removing the dirt and paint is the most arduous part of the job.

At this point, make such repairs to the mudguards as may be necessary. In all probability they have become dented and loose at the riveted joints. Dents may be taken out with blocks of hard wood and a hammer. If the tank has shown a tendency to ooze at the seams, clean the leaking places well with emery cloth and solder neatly, smoothing with a file.

Start the re-enameling with the application of flat white paint, such as white lead thinned with turpentine. This gives a

(Continued on page 99)

Home Protection

with an
ASTRA
Automatic
will cost little



Nearly every man wants a gun in the house—he feels better able to protect his family. We are able to offer these genuine Astra guns at special prices because we bought before recent tariff raises became effective. Really fine guns, beautifully finished, hard hitting. Use standard ammunition. Order direct from U. S. importers.

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Refinishing Your Motorcycle

(Continued from page 98)

reflecting surface that will make more brilliant the effect of the following coats. Use only the best enamel in the color of your selection.

With fine-grade sandpaper, smooth the priming coat when dry. Apply the enamel evenly, taking care to leave no brush marks. When this is thoroughly dry, sand again and apply the finishing coat.

Suspend each wheel from a nail by means of a cord fastened to the axle ends, and the work of painting hubs and spokes will be facilitated. If the tire side of the rim is rusted, clean well with steel wool, and enamel. Also note any loose spokes, and remedy by a turn of the nipples.

Parts of the engine that are not subjected to the intense heat caused by explosions and escape of gases, may be enameled; but the cylinders, exhaust pipes and muffler ought to have a coat of stove-polish.

Unless you wish to take the nickeled parts to an electroplater for re-conditioning, roughen them well with emery-cloth and cover with enamel.

Striping requires more skill than most amateurs possess. The result will be good if sufficient care is taken; but it is advisable to rely on the name of the manufacturer to give an ornamental touch to the tank. Buy two name transfers from an agency for your make of machine. With scissors cut within $\frac{1}{4}$ in. the outline of the work, and after giving it a thin coat of varnish apply the transfer immediately to one side of the tank. With a damp sponge peel off the supporting paper. Repeat this process for the other side of the tank.

In reassembling the parts, draw up all nuts carefully to insure their tightness. To retain the luster of the enamel, use soap and water (not gasoline) when washing; and if you have no garage, cover the motorcycle at night.

Dainty Trinket Box Made from Plank Cuttings



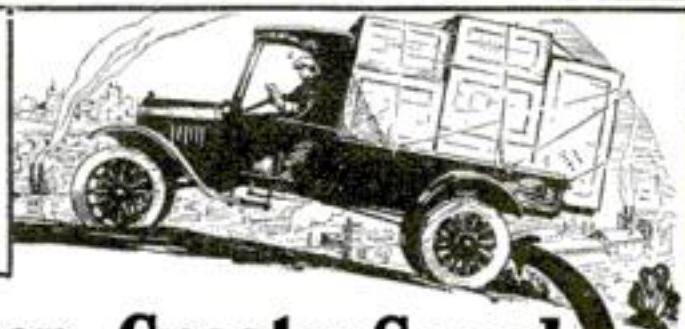
THE amateur carpenter and wood-worker can find a wealth of material if he knows where to look. In every carpenter's or builder's yard are plenty of odds and ends that can be made into most attractive articles.

The little trinket or tobacco box illustrated was turned from two end cuttings from a 2-in. elm plank. These had been glued together under considerable pressure after the facing surfaces had been planed. The outline was sketched on the end of a block that was to be the top of the box, and then roughly cut in straight lines with a saw before the turning began.

The inside of the cover, where it fits over the flange on the box, is turned with a slight taper, about one in eight, to insure a tight joint.—C. A. OL德ROYD.

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No need to invest your money in high priced cars when you can have a light car that will positively out-perform any of them! You can go anywhere—up in the mountains, through the lake regions over any sort of roads—cross country from coast to coast. The RUCKSTELL AXLE has solved the great problem for all time by combining POWER and SPEED. The simple movement of a handy lever provides TWO-PURPOSE PERFORMANCE as needed.

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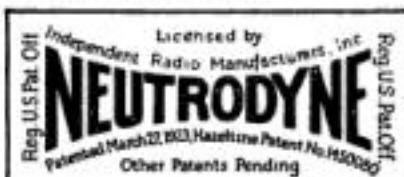


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New Howard 5-Tube Neutrodyne

This remarkable set has created a sensation among Radio enthusiasts.

Beautiful Black Walnut Cabinet with special Howard Neutroformers Tube Sockets and Rheostats.



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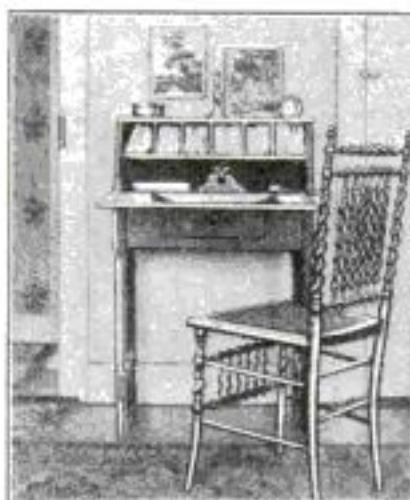


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Metallic Letter Co., 433-A N. Clark St., Chicago

Obsolete Washstand Converted into Neat Writing Desk

HOW a discarded washstand may be made into an attractive and useful desk, with very little work and almost no expense, is shown in the accompanying illustrations.

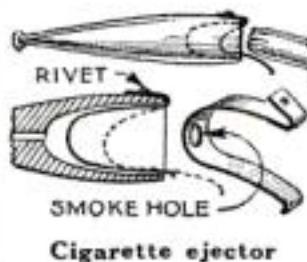


The old and useless washstand is shown above. With a few boards from boxes, it was made into the attractive writing-desk illustrated at the left.

The lower shelf is used for making the hinged cover, and packing boxes will supply the back, ends, narrow top pieces, and pigeonholes. Desk hinge supports or hinges and chains for the shelf, and a good varnish stain are the only supplies to be purchased.—GRACE SCHOETTLER, Buda, Ill.

Ejector for Cigarette Holder

CIGARETTE smokers should appreciate this ejector for disposing of butts in a cigarette holder. Drill a very small hole close to the large end of the holder. Then bend a piece of 3/16-in. wide aluminum ribbon or soft copper ribbon to fit inside, as indicated. A hole is cut in the ribbon to allow the cigarette to draw freely. One end of the metal is riveted to the holder and the other is free so that it can be pulled out sufficiently to dislodge the shortest butt.—L. B. ROBBINS, Harwich, Mass.



How to Fix a Balky Fan

(Continued from page 74)

nections and ends of wires, carefully removing the tape or binding cord where necessary. The test lamp method used for examining the starting coil can be used, of course, for further testing the motor windings.

Which of these repair methods to try, you may judge by reading the chart on page 74. When the trouble has been corrected, reassemble the fan, fill the oil cups (Fig. 6) with hard oil, petrolatum, vaseline, or whatever lubricant the fan instruction card calls for. Then open the gear box of the oscillator (Fig. 7), if the fan is of the oscillating type, clean it out and pack with hard oil.

All that remains is to start the fan and sit back and enjoy the breeze.

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Making Use of Cut Film in Camera Plate-Holders

THE present widespread use of cut film instead of dry plates for photographic purposes has led to the abandonment of many plate-holders. By making simple adapters, however, the photographer can utilize his plate-holders for films.

A piece of cardboard approximately the thickness of a dry plate, or a trifle less,

is cut the desired size. This board is then covered with photographic black paper, firmly pasted on the reverse side. On the front, four cuts are made across the corner, as indicated in the illustration, to form four corner pockets. The cut film is then inserted in this adapter and the whole loaded into the plate-holder.

Kits may be made easily in the same way to adapt smaller sizes of film to large plate-holders, as shown. They are also serviceable in adapting American film to foreign sizes. For instance, the 2½ by 3½ in., which is more widely used in foreign cameras than our own 2¼ by 3¼, may be cut from 5 by 7 film without waste.—HERBERT C. MCKAY.

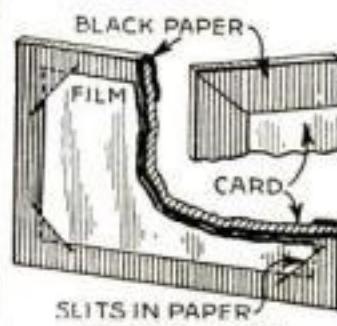
How to Give Aluminum Paint a Durable Gold Color

GILT paint, although beautiful when first applied, soon tarnishes, and it is expensive for large surfaces. Real gold leaf is absolutely permanent, but is difficult to lay and still more expensive. A beautiful permanent gold-like surface may, however, be obtained by using aluminum paint and then coloring the surface as follows:

Dissolve by digestion gum sandarac alone or equal parts of this and bleached shellac in alcohol, adding tumeric and dragon's blood in the proportions of 12 oz. sandarac or 6 oz. each of the sandarac and shellac to 1 oz. tumeric and 2 oz. dragon's blood to 1 gal. alcohol. Larger or smaller amounts should be mixed in the same proportions. Filter this through a cloth and apply with a soft brush. Solid aluminum articles may be treated in the same manner.

Bushing Serves as Simple Die

THE experiments of a homeowner called for a number of small sheet-metal disks and, as no punch press was available, a simple hand punch and die were made, as shown. The die is merely a bushing with a saw slot in which the stock is placed. The punch is driven through by a mallet blow.—R. H. KASPER, Philadelphia, Pa.



The construction of a film adapter



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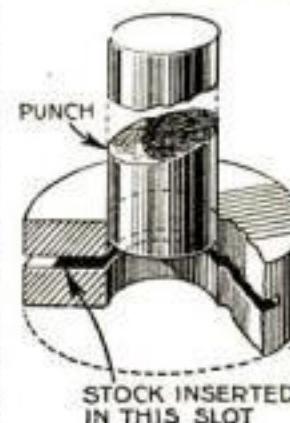
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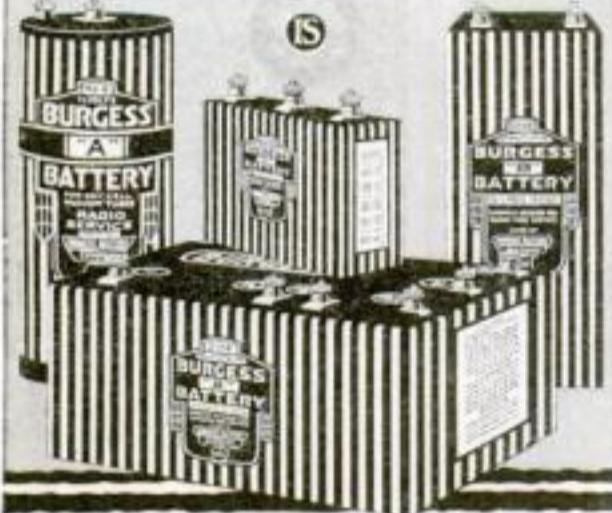
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The Shipshape Home



Clogged-Up Trap

One of the most frequent plumbing complaints in the average home, aside from leaking faucets, is that of stuffed or clogged sink traps. Without the proper tools, this is often most difficult to remedy. When confronted with this problem recently, the writer used a piece of scrap flexible automobile speedometer shafting with great success.

One end of the flexible shaft was frayed. This was inserted into the clogged trap and given a twisting motion. The



Cleaning a stopped-up trap with a length of discarded automobile speedometer shafting

material that clogged the trap was securely enmeshed so that it could be pulled out of the trap instead of being forced into the drainpipe, as would have been the case if a force pump or wire had been employed.

The shafting, which had been bought from an auto-wrecking concern for 20 cents, is now numbered among the writer's most valued plumbing tools. A short length of "BX," a flexible material used by electricians, may also be used for this purpose, but this material does not possess the great degree of flexibility of the speedometer shafting. An ordinary coil spring also can be used, as described in the February issue of POPULAR SCIENCE MONTHLY.—JOHN H. SCHALEK, Pittsburgh, Pa.

Bathroom Shelf

If you need a small shelf in a modern bathroom, or in any room where there is no suitable wall space, look around for a steam or hot-water pipe. Such a pipe will support a shelf about 9 in. in diameter. One has been used for more than a year to support an electric

stove, so the shelf is strong enough for any ordinary purpose.

Cut a piece of 1-in.-thick whitewood, oak, or other wood to the desired size, smooth it with sandpaper and screw it to an ordinary japanned iron shelf bracket, costing 10 cents. Hold the bracket against the pipe with a 5-cent automobile radiator hose clamp. A single clamp at the upper end of the bracket will be sufficient.

The shelf may be either round or hexagonal and enameled white. If a stove is to be placed on the shelf, protect the wood with sheet metal or thin asbestos.—M. MACDONALD, Brooklyn, N. Y.

Cleaning Varnish

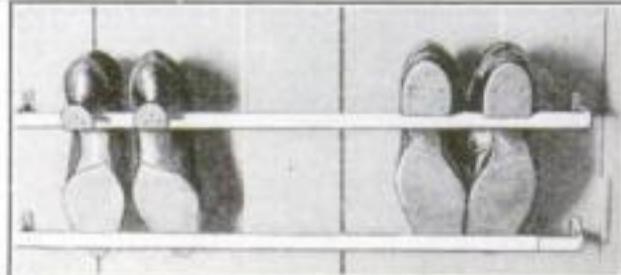
WHEN a varnished surface is not cracked, checked or peeling, but merely needs freshening up before it can be revarnished, I find the following method of cleaning is exceptionally satisfactory:

Dip some medium fine steel wool in slightly warm water and rub it over a bar of mild laundry soap until it lathers. Then scrub the woodwork with this until the dirt is loosened. Rinse clean with clean cool water.

Let the wood dry thoroughly and apply one coat of varnish thinned with turpentine. When this has dried hard, rub down with fine steel wool and put on another coat of varnish as it comes from the can.—A. J. HARSTAD, Wolf Creek, Mont.

Curtain-Rod Shoe Rack

A SERVICEABLE shoe rack inside a closet door can be made from two flat curtain rods. The top rod has a projection of 4 in., and the lower rod a projection of 2½ in. The heels of the shoes



Rack made of two flat curtain rods attached to inside of closet door

hang on the top rod and the lower rod keeps the toes in place.

This type of rack saves space and the shoes are kept in better order than if they were stacked on the floor or a shelf.—KENNETH B. MURRAY, Sturgis, Mich.

The Shipshape Home

(Continued from page 102)

Laying Bricks

LAYING bricks is not as easy as it looks, as most home workers who try it soon find out. I recently had to replace some brick underpinning beneath my house. What I did was to get a straight "two by four" a little longer than the wall was to be and placed it as a guide against the piers between which I was going to build the wall. This gave me a straight line to begin with, and then, as I finished each course, I raised the "two by four" by placing bricks beneath it, in each case allowing the edge to project about 1 in. above the edge of the course already laid.

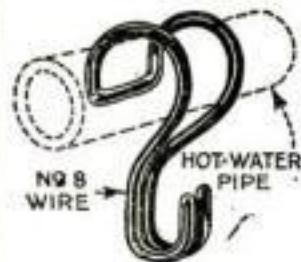
After each course, I smoothed mortar into the crevices and took care to run the trowel over the face side of the timber, so that it would fit snugly against the guide piers at the end.

If there had been no piers, I should have placed posts of substantial straight timber to guide the end of the "two by fours." This method soon gives the amateur mason a knack of laying bricks straight.—GEORGE T. BROSKI, Dumbarton, Va.

Kitchen Hooks

HANDY hooks for hanging the range shovel, dustpan, dust brush, stove poker, and various kitchen utensils, can be bent up easily from pieces of galvanized iron wire, about No. 8 gage and 12 in. long. Fasten each hook on the hot-water pipe extending from the back of the stove.

Very heavy articles or a great number of them, should not be hung on the pipes, which might sag, but small articles will do no harm.

**Filling Floor Cracks**

IN PAINTING old floors the cracks between the boards often present a difficult problem. Ordinary prepared crack-fillers are apt to crumble and leave unsightly gaps after a few months, if they are used in fairly wide cracks.

A method that has stood the test of years is to saw from $\frac{1}{2}$ -in. stock a number of strips varying in width from $\frac{1}{16}$ to $\frac{1}{4}$ in. in thickness and 3 or 4 ft. long. After brushing the dirt from a crack, choose a strip that will just fit into the space, coat it with glue on both sides and drive it into place. A larger strip of wood should be used to protect the thin strip while it is being hammered into the crack.

These strips easily can be planed to fit any crack, and a lasting job is the result.—J. P. BURBANK, East Milton, Mass.

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How to Build an Icebox

(Continued from page 71)

substances, is durable, and does not split or deteriorate.

To make the case, four $\frac{3}{4}$ -in. (or $\frac{5}{8}$ -in.) boards are nailed together temporarily and cut and planed to a finished size of $7\frac{1}{8}$ in. wide and 3 ft. 9 in. long. A leg 3 in. wide and 3 in. long is then laid out and the waste material is cut away so that the boards then can be opened out and made into two side pieces, as shown in Fig. 2,

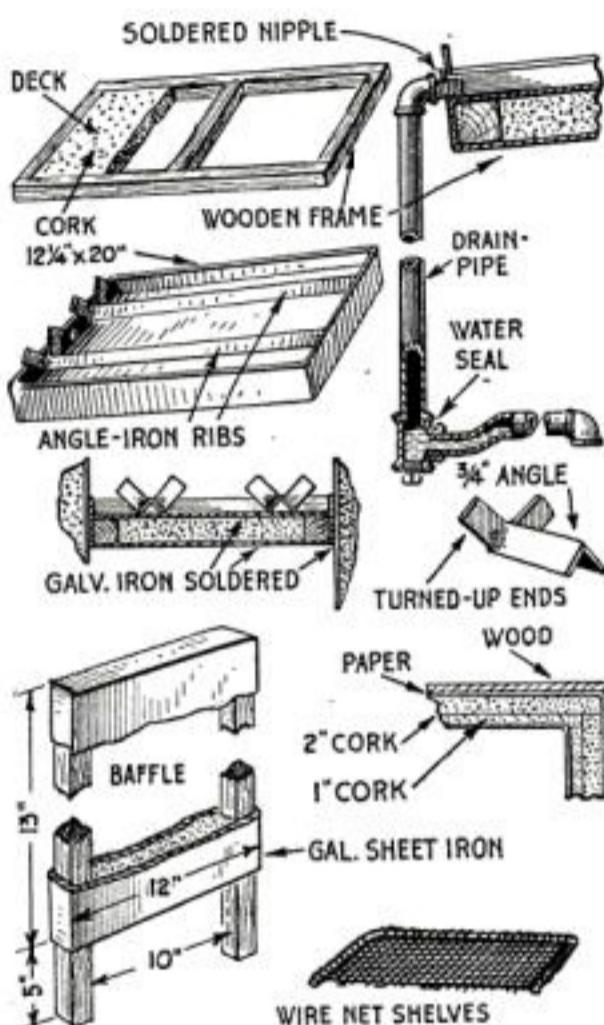


Fig. 3. Details of ice deck, baffle, drain, and water seal, insulation and shelving

the boards being nailed and glued together.

The top, $16\frac{1}{8}$ in. by 2 ft. 11 in., is then glued up and nailed on with finishing nails, set with a punch. The bottom piece, the same width and 2 ft. 8 in. long, is fastened in position and supported at the ends by 1 by 1 in. strips. The back is $\frac{3}{8}$ -in. thick tongue-and-groove ceiling.

The box is lined with odorless insulating paper, held in place with shellac. All the edges should be lapped and cemented.

Then obtain a quantity of 2-in. corkboard, which is made up in slabs 3 by 1 ft. Cork is cut easily with a coarse-toothed carpenter's saw.

Shellac, into which has been stirred some whiting to thicken it and give body, is used to cement the cork to the insulating paper. The corkboard is fastened to the wooden casing with $2\frac{1}{4}$ -in. flat-headed nails. These nails will sink into the cork about $\frac{1}{4}$ in. Too much force must not be applied or else the nail will be driven through the wooden casing.

Upon the 2-in. layer of cork another 1-in.-thick layer is applied. Care should be taken to "break" all joints, as shown in Fig. 3, and make them square and clean cut. All the seams should be sealed thoroughly with the shellac compound, which also is used to glue the second layer of cork to

(Continued on page 105)

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How to Build an Icebox

(Continued from page 104)

the first. Too many nails must not be used, for steel is a conductor of heat.

A lining of 16-gage galvanized iron is made to fit snugly into the wood and cork case. This is simple work, because only 5 soldered seams are necessary. The top, sides, and bottom are bent from one sheet and the back is another sheet.

The deck and baffle can be made up by the worker as described below and turned over to the tinsmith for covering with metal at the same time the lining is to be made.

The deck is constructed of 1 by 1 in. strips, as shown in Fig. 3. It is insulated with two inserted cork sections of 1-in. cork. The whole then is covered with light galvanized-iron sheeting. First one sheet, the width of the deck, is applied, and then another sheet, the under one, is fitted so that it extends around and up the sides for about $\frac{1}{4}$ in. It is soldered as shown in Fig. 3 and is finished by having two ends soldered on, one of which should have a close $\frac{1}{8}$ -in. nipple soldered in it. Upon this is screwed a $\frac{3}{8}$ -in. ell, forming part of the drain. Galvanized nails should be used in nailing the sheet metal to the wooden frame so that the heads may be soldered over.

Two 22-in. lengths of $\frac{3}{4}$ -in. galvanized angle iron are obtained. One end of each is split down its length for a distance of 2 in., the ends then being turned out, as in Fig. 3. These are soldered to the deck. The splayed ends of the iron runners prevent the ice from sliding down and projecting over the air chute.

THE baffle, which has a 5 by 10 in. opening at the bottom, is built like the deck—1 by 1 in. strips with 1-in. cork insulating insertions, covered with galvanized sheeting. The deck is soldered in as shown in Fig. 1 and should be 11 in. from the top at the drain end and 10 in. from the top at the other end. The baffle at the drain end is about 2 in. from the side; the other end of the deck is about 3 in. away from the side wall. The baffle is soldered to the lining and to the deck so that it is 2 in. away from the side wall.

Before placing the lining in the case it is best to solder in the $\frac{3}{4}$ -in. galvanized angle irons that support the shelves. Generally two shelves are installed, the first 5 in. from the bottom, the next 5 in. from the first.

The construction of the front of the box is as shown in Fig. 2. Only the vertical center piece needs to have cork insulation and be covered with galvanized iron. To the center piece, between the two service doors, are soldered the angle irons that carry the shelves.

The shelves are constructed of steel screening with a heavy galvanized-wire edging, the screen edges being bent over the wire edge. These are made 11 in. long by 12 in. wide, placed in pairs.

The swinging flap, which may be eliminated if a drain is provided in the floor, is to conceal the drip pan and swings upon two pivots. These pivots are made by screwing two heavy wood screws into the upper edge of the flap, one at each end.

(Continued on page 106)

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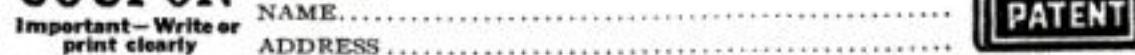
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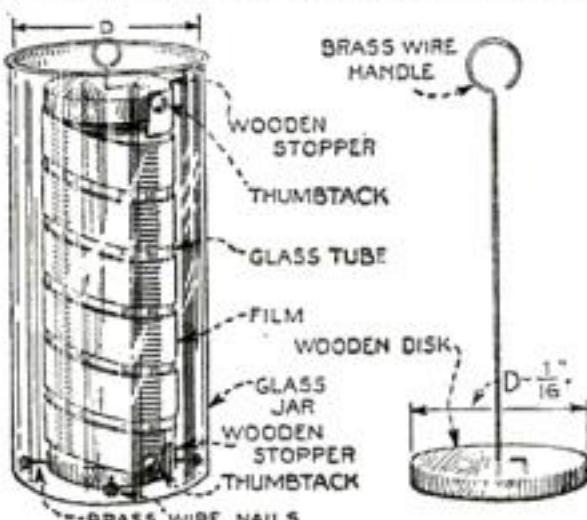
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Unique Method Simplifies Darkroom Development

THE developing device for small roll films illustrated has three advantages: It requires minimum developer; it allows the film to be handled without the hands coming in contact with the solutions, and it enables the photographer to inspect the progress of development without having to touch the film itself.

The film is wound on a glass tube or an incandescent gaslight chimney in spirals without overlapping. If non-curling film is used, the black paper also should be wound on the tube so as to lie between the film and the tube and prevent the gelatine's sticking. The ends of the film are thumbtacked to cork stoppers in both ends of the tube.

A wire loop is attached to the top stopper to serve as a handle and three or four



Wound around a glass tube, the films are placed in a jar containing the developer.

brass nails are driven into the lower stopper to within $\frac{1}{4}$ in. of their heads to center the tube in the developing jar. The latter should have an internal diameter (D) about $\frac{1}{2}$ in. greater than the diameter of the tube.

Before the top stopper is finally fixed, the tube is ballasted with several old nuts held in position with a few spoonfuls of plaster-of-Paris solution.

If three glass jars are provided for developer, fixing bath, and rinsing water, there is no need to touch the film until it is ready for uncoiling and drying. By cutting holes about 1 in. in diameter in the black backing paper, before winding on the film, development can be checked simply by holding the glass tube against the red light.

A further advantage of this method of development is that the developer can be left in the glass jar, ready for further use, provided an airtight cover is made of wood boiled in paraffin.—C. A. O.

How to Remove Road Tar

ROAD tar should be removed immediately after an auto is housed. If left indefinitely, the paint will come off with the tar, leaving the surface unsightly.

Gasoline will remove tar when fresh and soft, but after a very short time this is useless. Either lard or oleomargarine will soften the tar after it has begun to harden, that is, soften it enough to be removed without taking the varnish with it. Cocoa-butter also will be found a harmless solvent for tar.

How to Build an Icebox

(Continued from page 105)

and then cutting or filing off the heads. The pivots swing in the $\frac{3}{4}$ by 3 by 8 in. pieces that are nailed to the front legs, as shown in Fig. 1.

The ice door is constructed of $\frac{1}{2}$ -in. stock, lapping $\frac{1}{2}$ in. on all sides of the opening. The edges should be beveled and smoothed. The hinges and the catches should be of the regulation offset type, obtainable at any large hardware shop.

A sheet of 1-in. corkboard is applied to the doors, the edges being beveled, as shown in Fig. 1. The lower left-hand door is the most difficult to fit because the cork has to be trimmed to allow the door to close without jamming against the baffle. However, this requires but slight trimming. All the cork insulation then is covered with a galvanized metal cover.

The doors should be hung so that $\frac{1}{4}$ -in. refrigerator packing, which may be purchased in the larger hardware supply stores, can be placed as shown in Fig. 1.

The front is nailed to the completed box with long finishing nails, care being taken to see that the deck is properly nailed and supported, and that the baffle is held in place by several of the wire nails.

AFTER careful measurements have been taken, a hole is drilled through the bottom, and a piece of $\frac{3}{8}$ -in. galvanized pipe is cut and threaded so as to extend into the box. It is screwed into the ell of the deck. A small amount of white lead applied to the pipe joints will seal them perfectly and at the same time eliminate the necessity of using force in order to obtain a tight joint. Care must be taken not to break off the soldered nipple.

The methods of forming a trap for the drain is clearly indicated in the detail of the piping. The offset in the horizontal pipe should be as small as will serve the purpose of holding enough water in the trap to act as a water seal. The water may be discharged in any desirable place, the usual practice being to carry the drip pipe to the center and provide it with an ell, facing down, as shown in Fig. 3. If a drain seal from an old icebox can be obtained, it may be used instead. In cleaning the trap, use lye and hot water and, if necessary, unscrew the plug, as in cleaning a regular sink trap.

Care should be taken so as not to block the screen shelves, especially the cold air exit, with large boxes, or other objects. The cooled air flows down the air chute, cools the lower portions of the icebox, and returns to the top of the box to repeat the cycle again and again.

The nail holes should be filled with putty and the inside and outside of the box given several coats of white enamel. The shelves need not be enameled, as they are easier washed without.

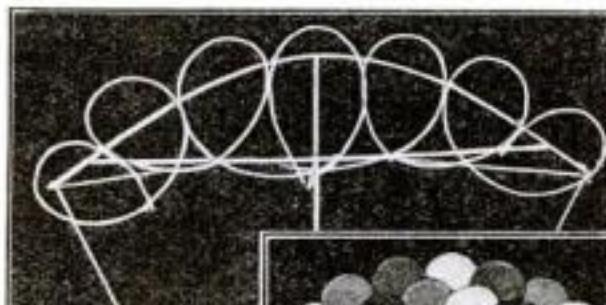
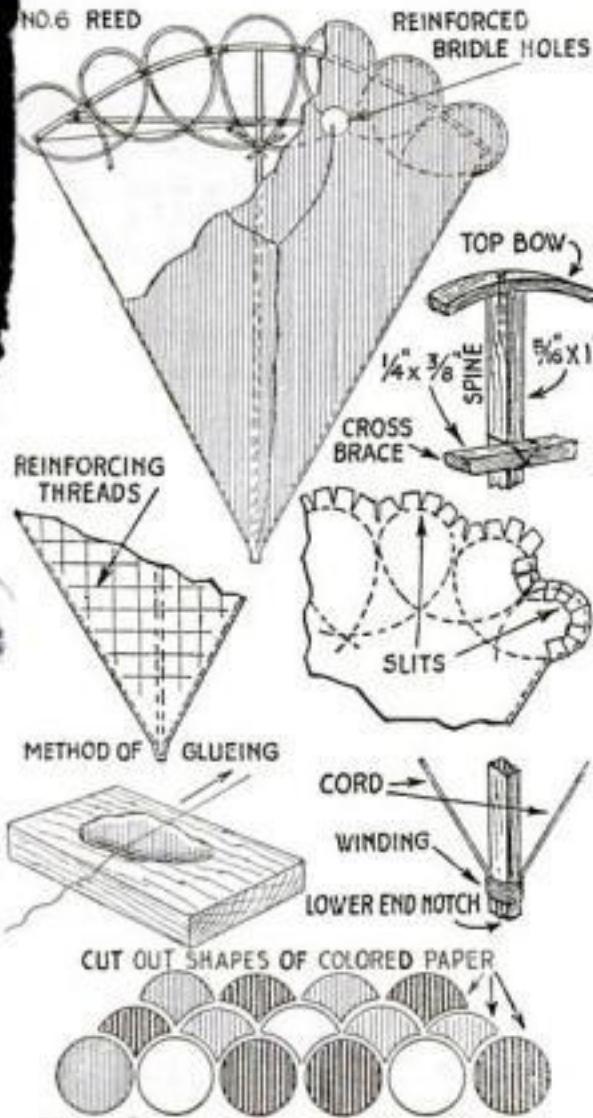
IF ANY difficulty is experienced in obtaining materials for building the icebox, such as cork, insulating paper, or door packing, the Information Department of POPULAR SCIENCE MONTHLY will be glad to supply the names of manufacturers, if you will send a self-addressed envelope and state specifically what you wish to know.

Balloon Vender Kite

(Continued from page 73)

can be bent and will remain in shape if heated over a candle. A toy gas balloon might be attached with a string so that it will float above the imitation balloons.

A good grade of tissue paper is perhaps the best all-around covering for kites. The greatest objection to tissue paper is that it slits badly. A small hole generally creases to a calamity. A good way to



How the kite is made, method of reinforcing tissue paper with glued threads, and photographs of framework and finished kite

offset this is to lay glued threads diagonally across the paper in two directions about 3 in. apart. The thread is coated by running it through a puddle of glue. Then lay it down on the paper. For large covers, a network of string at the back of the paper, not glued, helps to support the paper when pressed hard by the breeze.

First cover the entire kite with white or light blue or gray paper. It is best to paste the sheets together with not more than 1/2-in. laps. After enough pieces have

(Continued on page 110)

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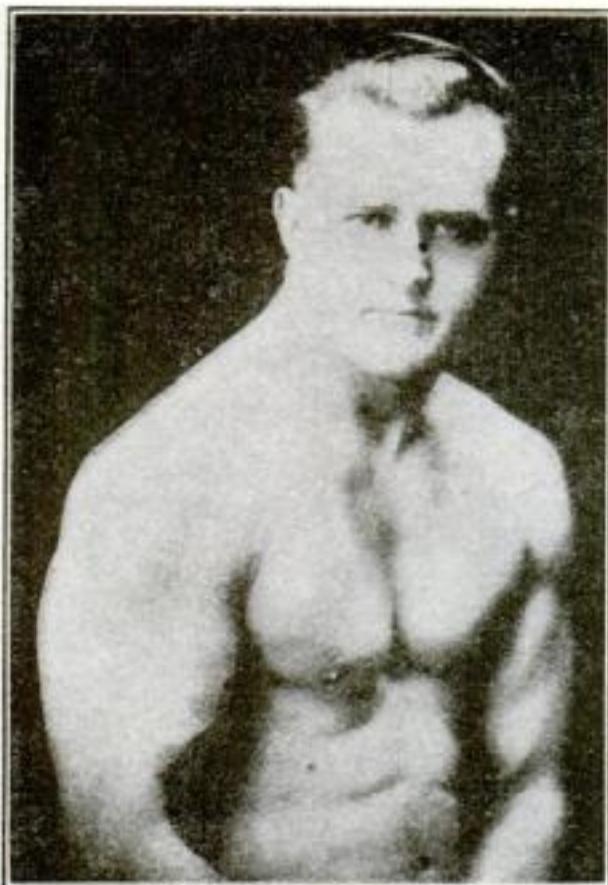
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Don't put this off another second. If you want to make the best of your life, you'll have to start right now. Come on, let's go—you and me—and you're going to bless the day you read this message. I'm going to make you work—you can bet your old shirt on that. But you'll thank me for it, 'cause—oh boy!—what a different looking chap you're going to be. Just for a starter I'm going to put one full inch on those arms of yours in exactly 30 days—and two inches on your chest in the same length of time. But that's nothing. Then comes the real works. I'm going to build out that neck of yours and put a pair of shoulders on you that will bulge right out of your old coat sleeves. I'm going to fill out your chest with a perfect pair of lungs that will pump real oxygen into your blood, shooting a thrill over your entire body and sending a quiver up your old spinal column. I'm going to put a ripple of muscle up and down your stomach instead of that roll of fat that is now hanging over your belt line. And while I'm doing this, I am also going to build muscle in and around every vital organ. You will have a spring to your step and a flash to your eye. In fact, you will say to yourself: "What a terrible oil-can I was turning out to be; why didn't I start this long ago?"

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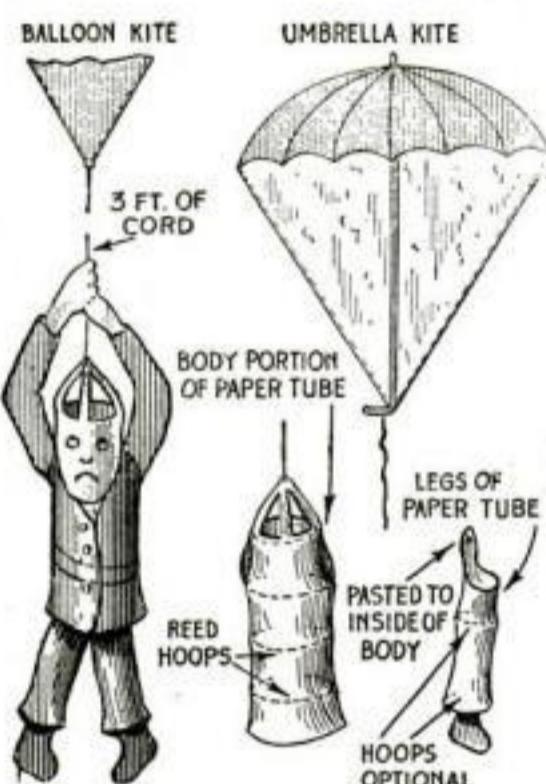
Balloon-Vender Kite

(Continued from page 109)

been pasted together, lay the paper on the floor and place the framework face down, on top. Cut about $\frac{3}{4}$ in. to the outside of the frame and string. Paste the outside flaps, turn over edges, and press them down. On the curves, slit into the flaps with scissors.

While the kite is still on the floor or table, some strips might be pasted over the framework at the back, thus reinforcing the cover.

Some of the balloons will not be full circles, but just the portion that shows.



The construction of the vender and suggestion for an alternative umbrella kite

The strings are represented by heavy black strips, rather out of proportion.

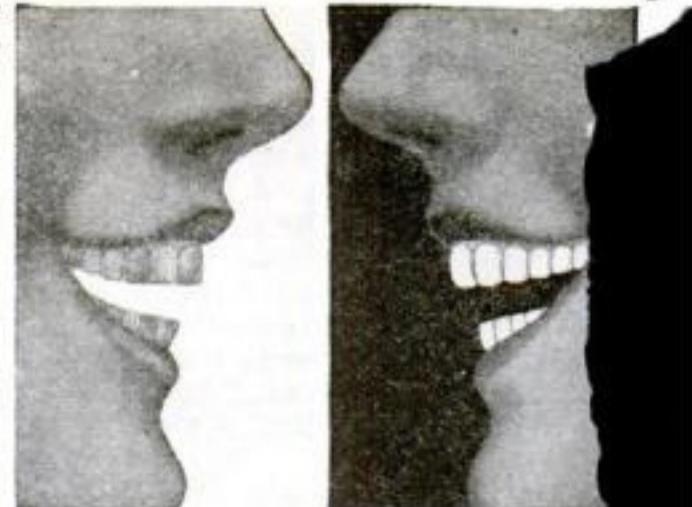
A three-string bridle is best for the balloon kite. Such a bridle can have a string attached about halfway from the spine to the outside point on either side, and another string attached to the bottom of the spine. Use little reinforcements of paper about the hole where the string of the bridle goes through the cover. The kite line is attached where the three strings of the bridle come together.

The balloon vender serves as a balancer and is hollow. There is no top to his head—the breeze passes into his body through this opening; it is his breathing apparatus. A series of reed rings down through the body will serve to keep the gentleman from total collapse. The arms and legs need not be stayed in such manner. The bottom of the legs are open to allow the breeze to pass through. The arms extend above the head and cling to the cord hanging below the kite. The man may have small rings in his legs, but it is not necessary to shape the hands or feet.

The clothes should be of dark paper and the face white, pink or yellow, with black markings for eyes, nose, and mouth. Black tissue can be used for such markings.

The man may be made of cardboard, but will not be as interesting as if hollow. He should hang 3 ft. below the kite, and if he is not sufficient balance, some fringes and tassels can be added.

The same kind of framework and the same hanging figure may be used with the umbrella kite shown above.



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In the bottom of an inverted barrel a hole is made through which a pipe is passed and driven into the ground. The barrel is fixed to the pipe so that it is held



The marker is drawn constantly nearer to the barrel

stationary. A "two by four" is used as a beam upon which a wooden marker is mounted in such a manner as to be free to slide. One end of a length of clothes-line is fastened to the barrel and the other end is attached to the sliding marker.

To operate the device, the beam and marker are turned about the barrel. This causes the line to wind up as on a drum, thus drawing the sliding marker toward the center. The resulting spiral trough made by the pointed marker serves to guide the gardener when setting out the plants.—C. M. WILCOX, Torrington, Conn.

Two Wooden Braces Hold the Ice-Cream Freezer Firmly

THE usual difficulty of trying to hold an ice-cream freezer while churning may be overcome quite easily by bracing the machine as illustrated.

Place the freezer on a bench of convenient height in the cellar and measure the distance from the metal cross piece to



How the
freezer is
braced

the floor beams above. Obtain two $\frac{3}{4}$ by 3 in. boards cut to this length and saw a V in one end of each. Locate each V over the metal cross piece and hammer the upper end of each brace under the rafter above. If the brace is a bit too short, a shingle can be wedged between it and the rafter.—D. D. SIMONDS.

When did you find your ideal tobacco?

Sooner or later we all
choose the perfect
smoke partner—

Here is an interesting letter from Mr. Charles H. Bishop of Chicago. It confirms the truth of an old proverb—"better late than never."

We hope that reading it may show some misguided pipe smoker the path to smoke satisfaction.

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But this Christmas I purchased Edgeworth, which he had tried after constant urging on my part—and he's satisfied!

Yours sincerely,
Charles H. Bishop.

We are glad Mr. Bishop induced his father-in-law to try Edgeworth, and we hope that the old gentleman will derive much pleasure and comfort from his pipe for many years to come.

But it seems to us a shame that he didn't become acquainted with Edgeworth many years ago.

We try to make Edgeworth a tobacco that most men will like regardless of age, and the evidence would seem to show that we do.

Of course, we don't hope to suit every man's taste, but a great many smokers have found Edgeworth "just right."

Why not let us send you a free sample of Edgeworth? Maybe it's just the smoke you've been looking for.

Your name and address on a postal to Larus & Brother Company, 59 South 21st Street, Richmond, Va., will bring you generous samples of Edgeworth with our compliments.

If you care to include your dealer's name and whereabouts we will appreciate the courtesy.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Ready-Rubbed for the same price you would pay the jobber.

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Radio's Part in Politics

(Continued from page 23)

himself an orator of note, suggested recently that radio will help restore oratory, since the public will demand facts and reasons, well and briefly stated, will tolerate only real eloquence, and will reject in disgust banal sentiment and wordy emptiness.

A phase of the subject that I mentioned above was commented on recently by Brigadier-General James Guthrie Harbord, president of the Radio Corporation of America, as follows:

"The fact that candidates are described and written up by the newspapers and magazines is not enough to satisfy the average voter. He wants to get at the sincerity and motives of the candidates and this comes only through contact. The glimpse of a man on the back platform of a train leaves an impression that no amount of writing will do. That personal touch is what men in public life have always sought, and they can establish that contact now to all parts of the country by radio. Radio will elect the next President."

SO FAR, speakers on political topics have, for the most part, confined their activities to short discussions between entertainment acts provided by the broadcasting companies. The radio spellbinder may have to follow the lead of the national advertisers and provide a band or a jazz orchestra to offer entertainment as an inducement to listeners-in to hear him.

This is no new thing in spellbinding. Senator James A. Reed of Missouri, an old-style, whirlwind spellbinder, engaged a small traveling circus to campaign with him when he last ran for the Senate. He set up his circus tent at the country crossroads, and after the band had attracted the farmers, he cut loose with politics. The radio campaigner might improve on this. The evening of politics might include music, comedy, and stunts from a good vaudeville show.

For serious political debate on topics in which the public is interested, the radio is made to order. It is interesting to reflect how many people might have heard the famous Lincoln-Douglas debates, had radio broadcasting been in use then. In those days a meeting hall that held 2500 people was monumental. Probably not more than 15,000 people heard Lincoln and Douglas in their whole series of seven debates over the state of Illinois. The course of history might have been changed had the whole country heard them by radio.

PUBLICISTS are greatly concerned as to how the Democrats and the Republicans will divide up the ether. They are worrying lest one or the other party monopolize radio broadcasting, or that rival spellbinders will spoil each other's speeches by talking at the same time. Radio engineers say these dangers do not exist, for several reasons.

In the first place, the expense of broadcasting prevents a monopoly. Neither party has a campaign chest that will per-

mit it. Second, radio fans would not stand for it, and broadcasting companies are extremely responsive to the wishes of the listeners-in. The broadcasting companies, through their associations, are dividing the time among themselves, or are using different wave-lengths without interfering with each other. Finally, there is the authority of the government, acting through the Chief Radio Inspector, to keep order in the ether. Secretary Hoover, who is responsible for the administration of radio regulations, has declared it inconceivable that any single group or person shall ever have the right to determine what communication may be made by radio.

"Radio is a public concern," he states, "impressed with public trust, and to be considered primarily from the standpoint of public interest."

So there seems little doubt that the radio spellbinder, if he has something to offer that radio fans care to listen to, will have plenty of opportunity to have his say by radio. It is up to him.

All signs point to radio's exerting a most profound influence in the presidential campaign of this year; and this year, remember, is only the beginning—an experiment even. Wider use of radio for political purposes can be predicted with certainty for the future. Political leaders will become more and more expert in its employment as time goes on. Skill in radio oratory eventually will become a necessary part of the equipment of the man in public life.

Each year there will be more radio receivers; hence, a larger audience for the radio spellbinder. And who dares say that through radio, through the better understanding of polities and political issues that it will bring to the average man, some day may not be realized the long existing dream of patriots—a perfect government?

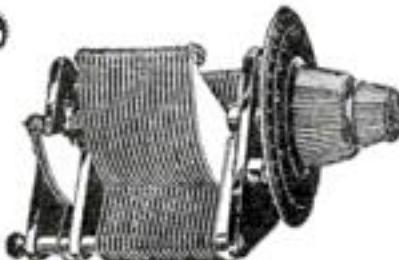
Hay Fever Pollen Drifts to Mountain Tops

IF YOU suffer from hay fever, you haven't much chance of escaping it, even by fleeing to the top of a barren mountain, according to an announcement made recently by Dr. William Scheppegrill, of New Orleans.

Hay fever is caused by the irritation of sensitive membranes in the breathing apparatus from the pollen of certain plants. If hay fever sufferers can keep away from this pollen, they are safe; but Doctor Scheppegrill, flying in an airplane, has discovered that clouds of pollen are carried by the wind to the height even of 15,000 feet! When the air cools, the pollen descends, a fact that explains why hay fever sufferers find their distress aggravated at night, in the fall, or on unseasonably cold days. Pollen was found by Doctor Scheppegrill as far as 10 miles from its source, from which he concludes that local campaigns to stamp out ragweed and other pollen-producing plants are of little benefit unless extended over wide territory.

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The Greatest Spectacle

(Continued from page 29)

of all the others, an assumption amply warranted by facts regarding the stars gained through the use of a wonderful instrument called the "spectroscopic." This instrument permits an accurate chemical analysis of a star to be made as readily as the analysis of a lump of earth could be made in a laboratory.

Most people probably know that ordinary sunlight passing through a prism splits up into seven components of different colors—violet, indigo, blue, green, yellow, orange and red. These seven colors are known as the solar spectrum. It has been found that the light given off by different substances in burning results in spectra that vary greatly, a fact that you can easily appreciate, if you have observed how various substances burn with flames of different colors.

By observation and experiment science has succeeded in classifying the various chemical elements on earth according to the colors of the light with which they burn. Hence, by permitting the light from various heavenly bodies to pass through the spectroscopic, astronomers can make chemical analyses of those bodies just as readily as if they had samples of them in test tubes.

THE most surprising fact developed by chemical analysis of the heavens is that apparently all matter in the sun and stars and throughout the expanses of space is made up of the same 92 chemical elements that compose our earth. In fact, certain chemical elements were discovered in the sun by means of the spectroscopic before they were found on earth. Helium, the gas now used to inflate airships, is a conspicuous example. At least one element in the corona or fiery halo of the sun has not yet been discovered on earth.

Having found out so much about the individual constituents of stars so far away that the unaided eye cannot discern them, it would seem that astronomers surely must have discovered just what sort of a place is this universe of which our solar system is so inconsequential a part. Well, not exactly, although they have formed a theory more astounding possibly, than exact knowledge would be.

Modern astronomers believe that the universe is without limits in its larger aspect, and theoretically without limits in its smaller. Beginning with the electron, which is the smallest particle of matter we recognize, we progress to atoms, molecules, worlds, solar systems, galaxies, supergalaxies—on and on, never reaching the end. Each of these units is infinitesimal compared with the next larger unit, and each group of units is infinite in number.

Of course, no one can offer absolute proof of such a theory. In all probability no one ever will be able to; yet it presents a picture more convincing than that of a universe that progresses so far, then stops—even though between the starting place and the end stretch countless billions of light-years.

Astronomers, however, are able to give

(Continued on page 114)



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The Greatest Spectacle

(Continued from page 113)

a more or less definite picture of the galaxy, or collection, of stars, to one of which our sun and its planets belong. Our galaxy is known as the "Milky Way." Though the nearest star in the Milky Way is so far away from us that on a telescopic photograph it appears as only one of thousands of tiny white dots, nevertheless it is comparatively close to us when we know that if a similar photograph were taken from some earth far out on the other side of the universe, our sun would appear on it only as another infinitesimal speck in that confusion of dots.

Photographs of the Milky Way show that the stars are distributed through it in widely varying quantities. One area may have 100,000, while in another there may be only a few hundred. From these photographs astronomers find that the Milky Way is circular and more or less flat in form—quite like the lens of a magnifying glass, or a discus. Its diameter is believed to be between 25,000 and 50,000 light-years, and its thickness about 6000 light-years. That is our universe; only one of countless universes that make up the infinite universe.

GLANCE at any one of the photographs that illustrate this article. Consider that every one of the tiny dots shown on it is a sun probably as large and as bright as ours. Consider further that around each one of those suns there may be whirling a group of planets, and that each of those planets, if it exists, undoubtedly has its own satellites corresponding to our moon. Then recall that there are between two and three billion of these suns in the universe in which the earth revolves, and that this universe with all its wonders quite likely is only one unit—an atom—of creation.

There you must stop, breathless and bewildered. To attempt to reach a conclusion would be futile. Scientific knowledge has made tremendous advances since the days when man believed his earth was the center of the universe, but it has not yet progressed to a stage where it can offer us any definite aid in solving the profound mysteries of this world in which we live.

Mr. Brown is preparing for an early issue another of his fascinating articles revealing the scientific wonders of the world about us.

Milk as Fuel Runs Train

IN AN astounding demonstration of the energy contained in milk, Dr. Herman N. Bundensen, Health Commissioner of Chicago, recently used dry milk in place of coal to run a train from Englewood to Beverly Hills, Ill., and back—a distance of about 10 miles. A thousand pounds of deteriorated milk, moistened and allowed to harden into lumps, was used in the test.

A skeptical crowd at Englewood saw Doctor Bundensen at the throttle of the locomotive, while the fireman shoveled dried chunks of milk into the firebox. The locomotive pulled a train of five coaches carrying 200 passengers.



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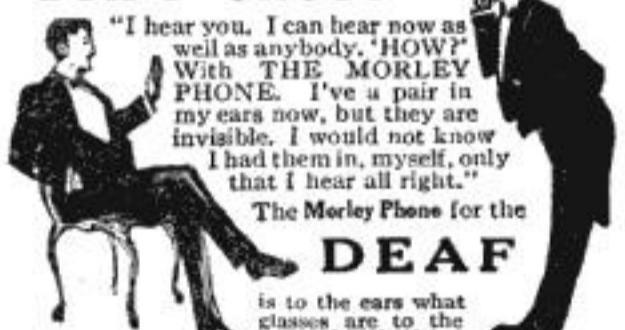
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Your Meals and Health

(Continued from page 41)

You probably have heard a great deal about vitamins in the last few years. These are mysterious and elusive components of food, essential parts of the diet. They are widely distributed in different foodstuffs, and I shall not attempt to tell, except in a general way, in what foods you may expect to find them. For the practical purpose of seeing that your diet is adequate, it probably will suffice to remember that you will get all the vitamins you require if you eat dairy products, green vegetables, fruits, and unrefined cereals.

Science now knows for certain that many diseases are due entirely to deficiencies in the diet or overindulgence in the wrong kind of food. I have mentioned some of the ills that may be traced to excessive eating of meat. In addition, the cause of goiter has been found to be an insufficiency of iodine. Acid mouth and improper formation of the teeth in all likelihood are due to insufficient milk and green vegetables.

The quantity of food to be eaten is largely a matter of occupation. For all people, though, three meals a day answer the eating program pretty well. The heaviest meal should be eaten at night, when most of us have the most leisure for digestion.

TO BOTH the slim and the fat I would say that the amount you consume is not the only factor in determining stature. That is why stout people, anxious to "reduce," frequently subject themselves to all the tortures of starvation without affecting their bulk appreciably. An intelligent selection of food in variety and abundance will keep you in health and, unless you are suffering from disease, should prevent your becoming either obese or emaciated.

Modern science does not admit that there are any such things as good foods or bad. Every food has its place in the diet. The problem of mankind is selection—the right amount of food and the right kinds, not the avoidance of certain foods.

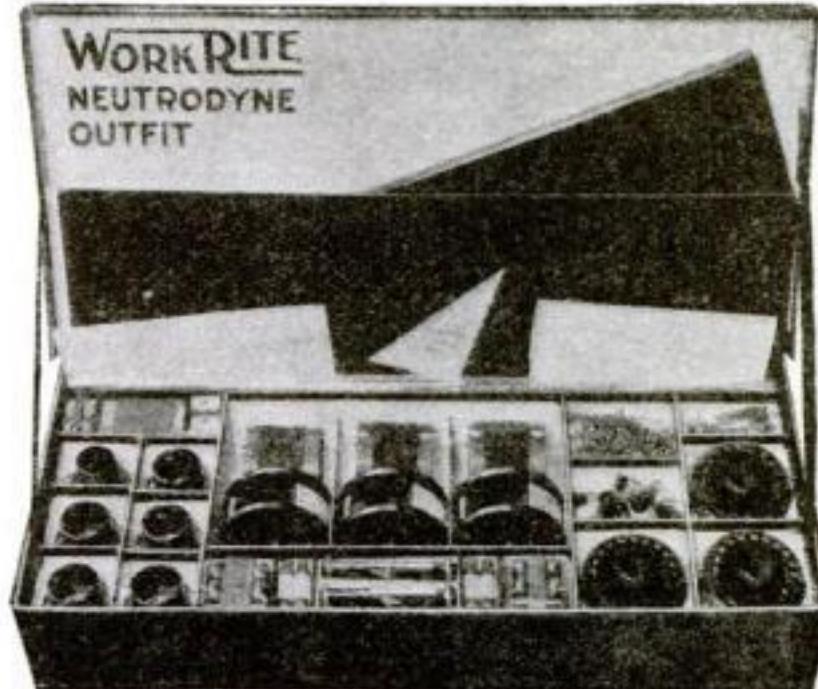
The only apparent exception to this rule is supplied by persons who seem unable to eat certain foods without suffering very real physical ills. Some of these acquire a skin rash when they eat strawberries. Others suffer distress after eating bananas. Milk, eggs, cucumbers, fish and other seafood, and tomatoes also are "indigestible" to certain people. Baked beans produce a burning sensation in others.

Most of these unfavorable reactions to certain foods seem to be due to peculiarities in the physical composition of the persons who are thus affected. If you find that you cannot eat certain foods in safety, my best advice to you is to avoid them, meanwhile supplying yourself with a satisfactory, well-balanced diet which you can both enjoy and digest.

It takes all kinds of people to make a world, and it takes all kinds of food to make a proper diet. If you have a favorite food, don't eat it too frequently, especially not to the exclusion of other foods of which you may not be so fond, but which are necessary to your bodily welfare. To do so will throw your diet out of balance and result in illness.

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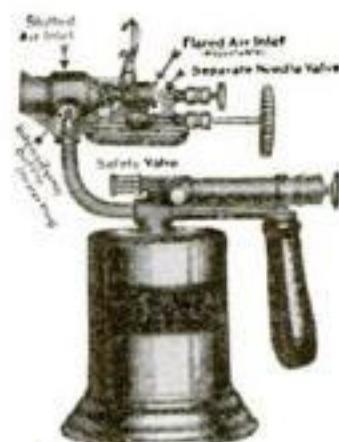
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Adventures in Home Ownership

(Continued from page 63)

The moisture from hot baths does not swell nor warp it, and it can be thoroughly washed without damage."

"You have very beautiful wall papers," Marion said as we looked about the various chambers. "I think in selecting them also it pays to buy good quality, don't you?"

"Most assuredly," I told her. "Cheap papers soon fade and have to be replaced at considerable labor expense. Good ones hold their colors and last enough longer to more than offset the additional cost. Another thing it pays to provide well for is the hardware. Its good lasting quality and right design lend a satisfying character to the home that is well worth the price."

"And how do you keep your floors looking so beautiful?" she asked.

"The wax finish is responsible," I explained. "A waxed hardwood floor is the best to look at and the easiest to maintain. With a moderate amount of care it always looks as good as new."

"Have you a sleeping-porch?" Jim asked.

"Yes, and that reminds me to show you the Venetian blinds," said I. "With them this porch is a screened piazza by day and a bedroom by night. You can raise them entirely or you can close the slats completely. The brightness of the early morning light always made outdoor sleeping objectionable to me until I learned about these blinds."

THE third floor with a maid's room, bath, and storage room suggested numerous possibilities. I pointed out that with dormers for lighting, it might provide two or three chambers, in addition to storage space, or a nursery, billiard, or radio room.

"Every available foot of attic space," I said to Jim, "may be put to some practical use if one has the vision and initiative to do it. You can have a lot of fun working out such schemes and doing the work yourself after the house is completed."

For discussion of the building contracts I invited Jim and Marion back to the cool piazza.

"One big advantage," I told them, "is that you'll have good, complete plans and specifications drawn up by a successful and reputable architect. He'll advise you about letting contracts for the work, also, if you desire, he will supervise the building operations."

"Would you advise letting most of the work to a general contractor and perhaps making separate contracts for the lighting, heating and plumbing, for instance?"

"It could be done that way. But the most satisfactory scheme, in my opinion, is the single contractor who will be responsible for the entire job. You then have just one reputable man to deal with, who usually can secure better terms, because of quantity buying and large operations, and can supervise the work more effectively than you can."

"Your architect will give you the names of dependable contracting firms with

sound financial standing. Get bids on the work from them in order to check one against the other for possible excessive costs. Then, unless the bids differ widely, give the job to the firm your architect considers the most efficient and conscientious."

"Of course you're a believer in written contracts?" Jim hazarded.

"Most assuredly. Explicit contracts, duly signed, and drawn with due regard to the lien laws are necessary safeguards," I told him. "The signature of both the owner and the contractor should appear not only on the contract but on the specifications and drawings, all of which should be included as part of the contract. This is most important in case of any disputes, particularly if action in the courts should arise."

"The architect, I believe, said something about there being three principal types of contracts to choose from," said Jim.

"**P**ROBABLY he referred to provisions for paying the contractor," I explained. "Three different methods are common. He may be paid a lump sum for the work he undertakes. He may be paid for all materials and labor, and receive in addition an agreed percentage of their cost. He may be paid for materials and labor and a fee for supervision fixed in advance. The lump sum basis has the advantage of settling the cost in advance and is preferred by most home-builders. The third method is better than the second. Neither settles the cost in advance, and unless the second is modified, the contractor may profit through increased expenditure for labor and materials."

"Now what about those lien laws?" asked Jim.

"In some states they make the owner of a house responsible for all bills," I explained. "He is the only person with material evidence of having received the benefit of labor and materials. Should the workers or material dealers not be paid by the contractor, the law may give them a preferred claim or lien on the property, and the owner may have to pay a second time for such work or materials as the contractor failed to pay for."

"That might just about ruin us, mightn't it?" said Marion.

"With a reputable contractor you have little to fear," I assured her. "Before making the final payment to the contractor, however, it is well to make sure that all his bills for wages and materials have been paid. If you borrow any mortgage money from a bank, building and loan or insurance company, its officials will probably help you in making sure on this point."

"Seems to me we've covered the ground pretty thoroughly," said Jim, glancing at his watch. "I can't think of another question to ask. All that remains, I guess, is to thank you again for much good advice and hustle out and take the big plunge into the game. Wish us luck, old man."

I am glad to record that the wish has been fulfilled.

Two Radio Receivers in One

(Continued from page 64)

four inches long by four inches wide.

Looking at the amplifier from the rear, it will be seen that the baseboard is so fastened to the amplifier panel that there is a space of one half inch from the extreme left of the panel to the edge of the baseboard, but the baseboard projects one half inch past the right edge of the amplifier panel, thus fitting into the half-inch space between the left edge of the detector panel and the detector unit baseboard. When fitted together in this way, the two units appear as a single unit.

If care is taken to follow the wiring directions given below, no trouble should be experienced in wiring the set.

Beginning with the bottom switchpoints of both sets of switches, connect each switchpoint of switch 4 with the corresponding switchpoint of switch 3. When the last or top switchpoint of switch 4 has been connected with a corresponding switchpoint of switch 3, one more switchpoint (the top one of the series) of switch 3 will remain.

THE next step is to run a wire from terminal 12 along the bottom edge of the panel to ground post 2. A wire then is run down to this wire from the switch arm of switch 4. Another wire is run from the F_1 terminal of socket 9 to the wire connecting terminals 12 and 2. Then connect a wire from rotary plates terminal A of condenser 7 with the wire mentioned in the preceding sentence. One terminal, A, of condenser 11, is connected with this wire.

Next, connect the G terminal of socket 9, not visible in the photograph, with one terminal B of the grid condenser and leak 8. The F_2 terminal of socket 9, hidden from view by the top of the socket, is then connected with the B terminal of rheostat 10. Terminal A of rheostat 10 is connected with terminal 13.

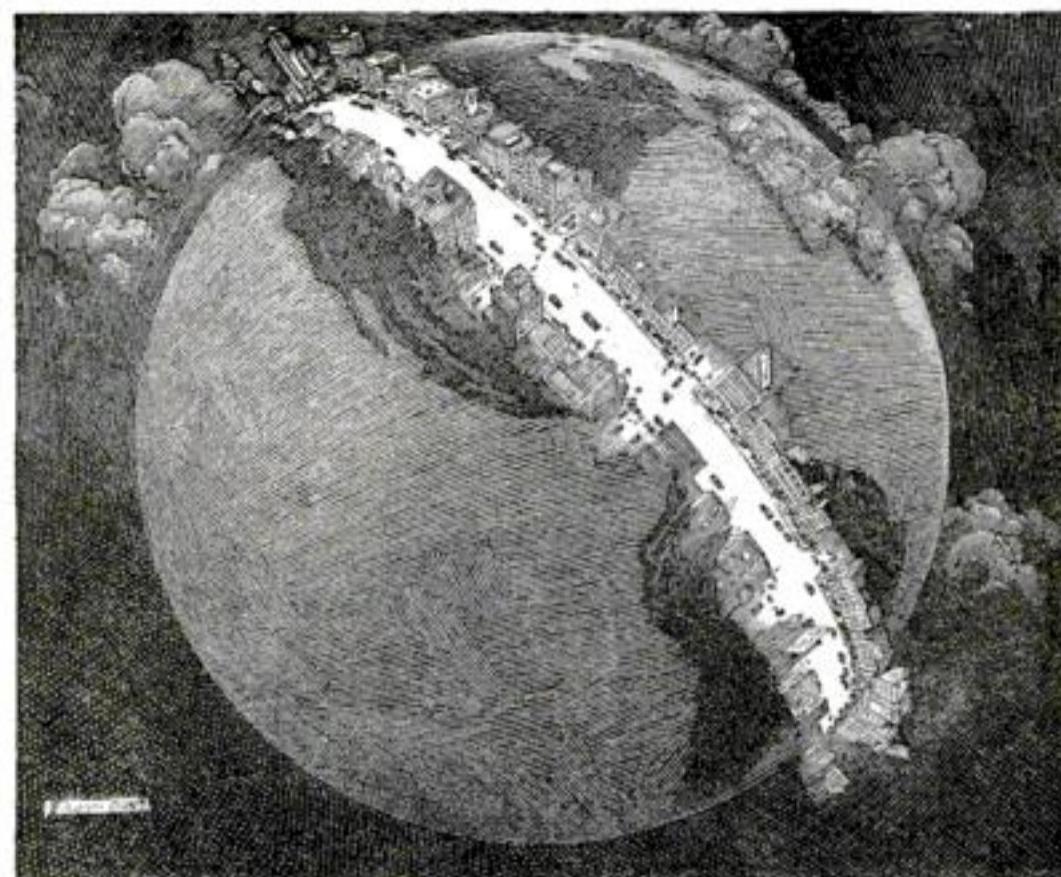
The aerial post 1 then is connected with the switch arm of switch 3. The D terminal of jack 15 connects with terminal 14.

The variocoupler now can be placed in position and wired into the circuit. Run a wire from the stationary plates terminal B of condenser 7 over the A terminal of grid condenser and leak 8, thence to the beginning or top end of the stator winding 5 of the variocoupler and terminating at the remaining or top switchpoint of switch 3. A wire is used to connect this wire with the A terminal of the grid leak and condenser 8.

The first tap, at the tenth turn, of the stator winding is connected with the wire connecting the top switchpoint of switch 4 with the second switchpoint of switch 3. The second tap at the twentieth turn is connected with the next set of switchpoints, and so on down the line of taps till the last tap at the sixtieth turn is connected with the last set of switchpoints at the bottom of the panel. A glance at the wiring diagram will show how this is done.

Now connect a wire from the B terminal of condenser 11 to the A terminal of jack 15, and also connect one lead of the rotor winding with this wire. The other lead of the rotor winding is connected with the P

(Continued on page 118)



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Two Radio Receivers in One

(Continued from page 117)

terminal of socket 9, completing the wiring of the detector unit.

In wiring the amplifier, connect two wires—16 and 17—with the P and B terminals of transformer 24 so that they can be slipped into the B and C terminal posts of jack 15.

Run a wire connecting terminal 21 with the F₁ terminals of sockets 18 and 19.

Next, connect terminal 20, the A terminal of rheostat 28, and the A (positive) terminal of C battery 26. The B terminal of rheostat 28 is connected with the two F₂ terminals of sockets 18 and 19; the G terminal of transformer 24 with the G terminal of socket 18; the G terminal of transformer 25 with the G terminal of socket 19. The two outside terminals D of jacks 22 and 23 are connected together, and with terminal 27.

The P terminal of socket 18 is connected with the A terminal of jack 22; the P terminal of socket 19 with the A terminal of jack 23; the P terminal of transformer 25 with the B terminal of jack 22; the B terminal of the transformer with the C terminal of jack 22. The two F terminals of the transformers next are connected and a wire is used to join the connecting wire with the B (negative) terminal of C battery 26.

This completes the wiring of the receiver.

IF THE detector unit alone is to be used, the positive A battery lead is connected with post 12; the negative A battery lead with post 13; the positive B battery lead with post 14, and the positive of the A battery and the negative of the B battery are joined together.

When both units are to be used, the battery connections for the detector unit remain the same. Wire 16 is connected with the B terminal of jack 15; wire 17 with the C terminal of jack 15; post 20 with post 13, and post 21 is connected with post 12.

Post 27 is connected with the highest voltage terminal of the B battery. Best results are obtained with the UV-199 and C-299 tubes if 45 volts are used for the detector and 90 volts for the amplifier. When it is desired to cut down the weight of the outfit, as low as 22½ volts can be used for both detector and amplifier. As a matter of fact, I have had fairly good results with a B battery voltage of 4½ volts obtained by using a 4½-volt C battery.

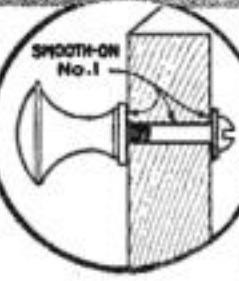
The knack of tuning the set is acquired easily. The grid leak resistance should be adjusted to the medium position. The tickler coil then can be set at 90 degrees to the stator coil and various combinations of switch settings can be tried to determine the best combinations for a particular station.

At each setting, the variable condenser is adjusted through its range until signals are heard. The rheostat should be turned on sufficiently to give fair signal strength, but not enough to cause the tube to oscillate. When a signal is tuned in fairly well, adjust the tickler coil.

Slight readjustment of condenser, grid leak, rheostat, and tickler coil settings will enable you to clear up the signal and bring it in good and strong.

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PACK the Smooth-On around the bolt, washer and on the threads, and the handle can never again come loose. Try the same trick on any loose tool, knife, or umbrella handle, door knob, etc., and the result will surprise you.



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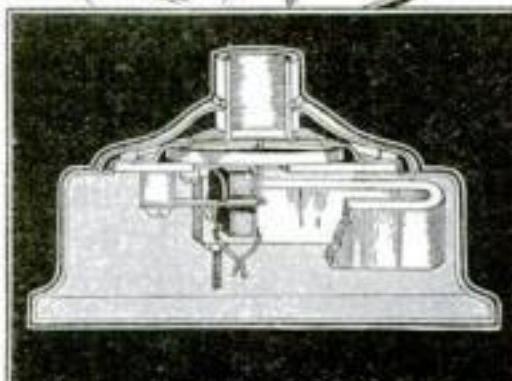
TQRZ-ZRT-5PH8

Here Are Correct Answers to Questions on Page 60

1. Because he has larger muscles with more muscle fibers in them. They can exert stronger pulls than the smaller muscles of a woman. This difference in the size of the muscles is part of the general difference in the size of the body, women being, usually a little smaller than men.
2. If you have a burning glass you can concentrate sunlight through it and set fire to paper or wood shavings. With a piece of steel and a flinty stone you can easily strike a spark just as our great-grandfathers did before matches were invented. With a little thin paper or very dry cotton to serve as tinder you can nurse this spark into a flame.
3. The thickness of the earth from pole to pole is 7900 miles. It bulges a little in the middle and its thickness at the equator is 27 miles more than at the poles. The distance around the earth on the surface is 24,900 miles. The highest mountain has about the same relation to the size of the earth as the thickness of a sheet of paper pasted on an orange.
4. The Dead Sea is very salty. It contains nearly 25 per cent of salt and there is no known fish that is able to live in so strong a salt solution as this.
5. Whenever a glacier reaches as far as the sea the end of it flows out slowly into the water. Pieces break off and float away. These are icebergs.
6. In the wood are a great many very small holes, or cells. Some of these have a little moisture in them. When the wood gets hot, this moisture turns to steam and bursts the little cells in which it is. This makes a noise like a small explosion and a great many such noises together make the crackle of the fire.
7. The sulphur-bottom whale, which may be as much as 85 or 90 feet long and may weigh nearly 100 tons. No prehistoric animal was as bulky as this, though two or three of the great extinct reptiles may have been a little longer.
8. So far as we know they cannot perceive images as our eyes do, but they can tell the difference between light and dark. Many plants will turn their leaves toward the light.
9. Probably gold. Metallic gold was to be found in the beds of streams. It was used for ornaments before any other metal was discovered. The first metal put to practical use was copper, made into knives and other implements at least 6000 years ago.
10. We are not sure, but it is probable that they migrated from Asia across the Behring Straits thousands of years ago. The easternmost point of Asia was probably connected then with Alaska by a land bridge, since sunk beneath the sea.
11. In the same way in which blotting-paper absorbs ink. The water is taken up into the millions of tiny holes between the fibers in the cloth of the towel.
12. Because that is the shape with which a certain amount of air can be inclosed by the least possible amount of the soap film. The film tries, as all matter does, to draw itself as closely together as possible. The bubble gets as small as it can without bursting and letting out the air inside.



THE mechanical principles of Magnavox Reproducers are as marvelous as the vocal chords of a great singer.



The Reproducer Supreme with a Human Throat



M4



R3

IS

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MAGNAVOX Radio



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PIONEERING work in the oil burner field is over. The past few years have seen oil burning for Domestic Heating and commercial purposes definitely accepted. The Oliver Engineers have developed a furnace burner without noisy motors, electricity or moving parts—efficient to an unknown degree—Listed as Standard by the Underwriters' Laboratories and already tested by two years of actual use in thousands of homes. Sales of the company have gone to an unprecedented peak. Over two hundred thousand homes have already been equipped with burners by the Oliver Oil-Gas Burner Company—direct from the factory. This is but a meagre indication of what can be accomplished through a thoroughly organized national wide distributing organization.

A Proved Proposition

As a logical course we now wish to have permanent dealers in every city, with Distributors to cover Counties and Sections. We will expect these men to fill orders created by our national advertising, to take over retail business heretofore handled direct from the factory, and to arrange selling and servicing facilities in their own territories.

This is not an untried proposition. The sales records of individuals already working under this plan have been phenomenal. The completeness of the Oliver line, which includes a burner for every type of furnace, cook stove and heating stove, makes

every householder a prospect. The selling season is 12 months long.

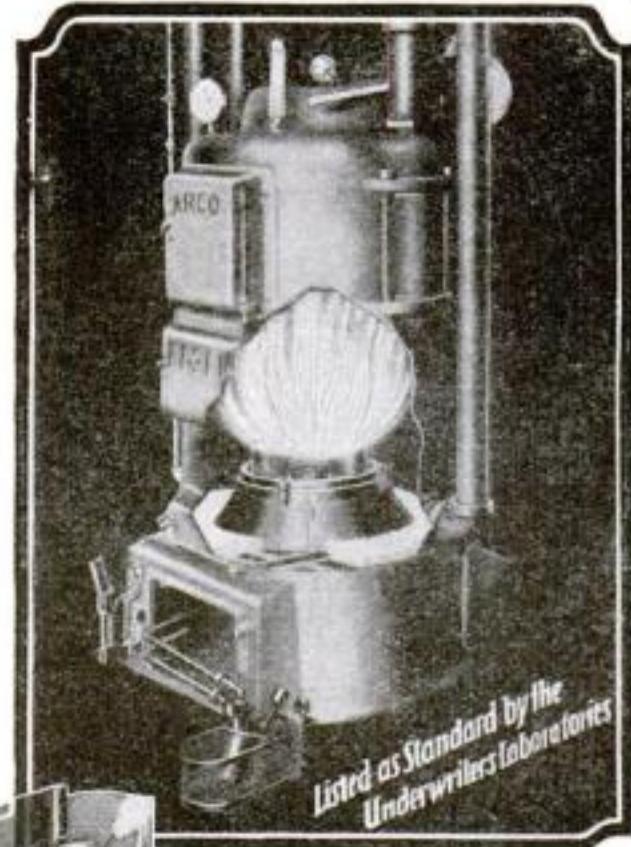
An Opportunity that Must Be Grasped Quickly

If you are the type of man who would have realized the possibilities for money-making with the inception of the automobile, you are likely the type of man we are looking for. A proposition can be outlined to you that will be entirely commensurate with your position and ability.

We seek men to whom we can lay down definite figures of business done—with reference to any city or territory. The general plan of Oliver territory organization is briefly explained under the captions The Oliver Distributor, the Associate Distributor, and the Sales Agent herewith.

Write for Sales Plan

It is advisable that interested parties should get in touch with us at once. We have prepared a complete prospectus which outlines our whole proposition. It will be sent you upon request. More definite information can and will be given if you will indicate on the coupon or tell us in a letter, the type of Oliver Territory in which you are interested. Write or wire at once to



The Oliver line includes 16 models of burners for every type of furnace, cook stove, heating stove, water heater, etc.

THE THREE TYPES OF OLIVER TERRITORIES

THE DISTRIBUTOR

Oliver Distributors receive appointment in logical Distributing Centers with exclusive rights usually covering several counties. They usually operate on a retail basis in one or more counties and furnish merchandise to Associate Distributors in the other counties of their territory.

2 THE ASSOCIATE-DISTRIBUTOR

The Oliver Associate Distributor operates in one or more counties on an exclusive basis, where he is expected to have facilities for selling, installing and servicing burners. He receives merchandise direct from the factory or from a Distributor.

3 THE SALES AGENT

Oliver Sales Agents act as city dealers or may receive appointment for territories on either exclusive or non-exclusive basis.

OLIVER OIL-GAS BURNER

OLIVER OIL-GAS BURNER CO.

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CANADIAN DISTRIBUTOR: OLIVER BLDG., TORONTO, CAN.
Oldest and Largest Manufacturers of Oil-Gas Burners in the World

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OLIVER OIL-GAS BURNER CO.
Dept. 754, St. Louis, Mo.

Please send me full details of the New Oliver distributor and dealer plan. This does not obligate me in any way.

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EVERY Scarlet Tanager that you see flashing through the woods this Summer will remind you of this black-tipped, lacquer-red Duofold Pen—of its color, symmetry, and grace and beauty.

And many a time you'll be glad we bought this space to remind our sportsmen friends [and sportswomen, too] to take this sturdy pen along.

Duofold's point, if not abused, is guaranteed 25 years for mechanical perfection and wear—that means it can "rough it" along with you, as no other pen would dare to do.

It's a point so smooth you can get real

penmanship results on the old camp table, or on a friendly rock, if that's handier.

So keep the Duofold nestling in your pocket, or slung about your neck from a ribbon or chain, and you'll be able to settle down anywhere and dash off a few lines to the folks back home.

Lest you forget, cut out the Scarlet Tanager right now, and keep it in your pocket as a sure reminder to stop at the first pen counter you come to.

The genuine Duofold is always stamped, "Geo. S. Parker—Lucky Curve." So don't let copies deceive you.

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